THE

ELECTRICAL REVIEW.

VOL. LXVII. DECEMBER 30, 1910. No. 1,727.

ELECTRICAL REVIEW.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1911 EDITION

NOW IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,

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1910: SOME REFLECTIONS.

BEFORE the next issue of the ELECTRICAL REVIEW appears we shall have passed into a new year. Manufacturers and others who complete their accounts at December will be occupying themselves with the closing of old books and the opening of new, seeing how they stand in such matters as profits and losses, and launching out with new resolves with the idea of making 1911 a better year than its predecessor. In recent years representatives of some sections of the electrical industry have spoken as though they eagerly awaited the termination of the twelve months, as things had been too bad to dwell upon, and the turn of the year might be expected to bring with it also a turn of the tide in their favour. Such expressions of view have not been so numerous in the closing weeks of 1910, for while balance-sheets and reports of 1909, which have come under discussion during the year, have been unpleasant, they have generally been supplemented by hopeful remarks either in the directors' report or in the chairman's speech. It is the Englishman's privilege to grumble, and he, generally speaking, avails himself of that privilege to the full, whether he be agriculturally or industrially inclined; but in electrical circles his grumbling has recently related more to the events of the past, and in regard to current affairs and prospective business there has been of late a distinct note of optimism. This is a satisfactory mood in which to end a chapter, as it should carry us forward buoyantly into what we trust is to be a busier and more profitable year. Our hopes all lie that way, and so do many of the indications, but unfortunately our steps are dogged by the haunting figure of the price-cutter. Would that this gaunt spectre could be effectually laid during the coming 12 months, so that with increasing volumes of business for both home and abroad, we could place the troubled branches of the industry in a more healthy position.

The matter of supreme interest in 1910 has undoubtedly been the great progress that has been made toward the supersession of the carbon-filament lamp, the street gas lamp, and the domestic gas mantle, by the metallic-filament type of lamp. We have not been able to make the latter at such a rate as to keep pace with the requirements—far from it. The lamp-makers are extending their manufacturing facilities in England, but we doubt whether their new factories are either expected or intended to be sufficient wholly to substitute British-made articles for the very large number of tungsten and other metal-filament lamps which are being brought into the country. Some of the new works will probably be starting operations early in the year, but there is a big demand ahead to meet the needs of new consumers, and normal replacements, as well as for export and general purposes. According to one authority, the change-over process has, generally speaking, been effected in business-premises, shops, and so forth—though it is easy to name important exceptions—but

has yet to be made in large numbers of private residences, particularly those of comparatively small consumers. Here, those who are not too well occupied with other things might concentrate their attention. There can be little doubt that when small consumers learn to the full the economy lesson that is awaiting them, their daily conversation with their gas-consuming neighbours and friends will do more for the cause of electric lighting than all the efforts of the most aggressive, enlightened, and humorous of our publicity organisations.

We have observed with great satisfaction during the past year the enterprising efforts of electricity works authorities in a number of places to prove beyond a shadow of doubt that nowadays the old and once sceptically regarded cry of electricity being the "poor man's light" is absolutely true. If we could only simplify the problem that is presented by the gas cooking stove, which came so opportunely to the help of the gas companies, so that electricity could be economically employed in the average household for all purposes, electricity would advance by bigger leaps and bounds than ever before. The greater attention that manufacturers of heating and cooking apparatus and station engineers have been devoting to this department of the industry during 1910 encourages a hopeful view as to an early issue of importance in this connection, especially bearing in mind that electricity supply authorities are simplifying their charging systems for the convenience of the man who wants to adopt electricity for all purposes through one service at a uniform or contract price.

Readers of the Electrical Review will hardly expect, in an article of this description, a detailed reference to all the various efforts that have been made from end to end of the Kingdom to adapt prices for energy to new conditions, conditions which include falling revenues and the necessity for regarding the consumer's convenience and understanding. Innumerable efforts, some of them, no doubt, only tentative, have been recorded from week to week in our pages, and when the time is ripe for investigating their success or failure as indicated by results, the movement will be one for interesting analytical treatment which may point the way for greater success everywhere.

Little reference to the electrical affairs that received the attention of Parliament is called for—for electrical schemes have been few, and St. Stephen's has been fully engaged upon purely party politics. Labour troubles have been serious, but these have only indirectly affected electrical manufacturing, though it may be that they will leave a certain mark upon some authorities whose business it is to supply electricity for industries carried on in the areas of the turmoil.

Our regular readers will have observed the progress that has been made in the application of electricity to the textile, coal-mining, iron and steel, and many other national industries. The effect of this has been felt not only by those carrying out the actual work of installation, but the "big power companies," as we have always called them, are in most cases feeling a substantial benefit which, though late in the day, is well-merited, and is better late than never. Every electricity works whose area is of a suitable character has been feeling the benefit, too, in its day-load—a benefit which has gone a good way, though not far enough financially, toward compensating for the reduced consumption of energy for lighting purposes. We have recorded many interesting cases of power station systems which have been reorganised, and in which modern plant has been substituted for antiquated, extravagant, and wasteful machinery, &c., and have shown the economies in cost of production which have attended or resulted from such admirable—though too long delayed—efforts.

Everywhere there is a striving after greater efficiency and economy. The manufacturer has been straining every nerve to produce his goods at a lower price without affecting the British reputation for quality; the electricity supplier is ever striving to get his fuel consumption, and his other costs per unit, lower and lower; and the consuming public, as they can get their bills for energy shortened and the lives of their metal-filament lamps lengthened, will help the cause of both the manufacturer and the electricity supplier, for it is cheap electricity advertising itself which will bring increased prosperity, because it will add to its own popularity.

Railway Disasters.

Once more we have to lament the occurrence of a terrible disaster—at Hawes Junction, near Carlisle — the horror of which is intensified by its taking place on the eve of the Christmas festivities. To the anguish of broken limbs and crushed bodies were added the terrors of fire, which, commencing at one end, spread along the train and quickly consumed all but two coaches, which remained on the rails, and thus could be dragged away from the rest.

Why should this crowning agony be allowed to continue to threaten travellers by rail? It invariably arises from the use of gas carried on the coaches—a practice which is wholly unnecessary, and in these days cannot be justified on any grounds whatever. We have frequently—too frequently—had occasion to emphasise the danger of using gas for lighting trains, a danger which has been pointed out by the Board of Trade Inspectors, though no action has been taken by the authorities with a view to its abolition. In this instance, so far as we can gather from the various reports in the daily Press, only the restaurant car carried gas tanks; these exploded, or were burst open by the collision, and the resulting fire was propagated from coach to coach. Presumably the train was lighted by electricity, for if gas had been installed on all the coaches, the progress of the fire must have been much more rapid than it was.

But there is no need to carry gas even for cooking; this can be done with electricity just as easily as the lighting is done, and with far greater convenience and comfort than cooking by gas.

It is high time, therefore, that the use of gas was forbidden on railway trains, as a barbarous and dangerous custom intolerable in these days. No instance is on record in which a fire has occurred, after collision, due to the use of electric lighting, which is usually carried out with a pressure of only 24 volts, giving practically perfect safety.

If electric track signalling had also been in vogue, this accident could not have happened. No doubt there are many difficulties in the way of its adoption, but it has been tentatively adopted on some of our lines, and is extensively used abroad. In this direction also, therefore, we hope to see progress effected, and if the authorities will only wake up and take energetic steps towards that end, besides carrying out their veiled threat of some years ago to make electric lighting compulsory, we may confidently hope to see a great reduction in the number of accidents recorded. The British railways already stand pre-eminent in respect of their safety as compared with those of the rest of the world; let us not rest content with this measure of distinction, however, but go on and make them perfect.

THE HYDRO-ELECTRIC NITROGEN WORKS AT NOTODDEN, NORWAY.*

Some years ago the Norwegian Prof. Birkeland and Engineer S. Eyde succeeded in solving the problem of extracting

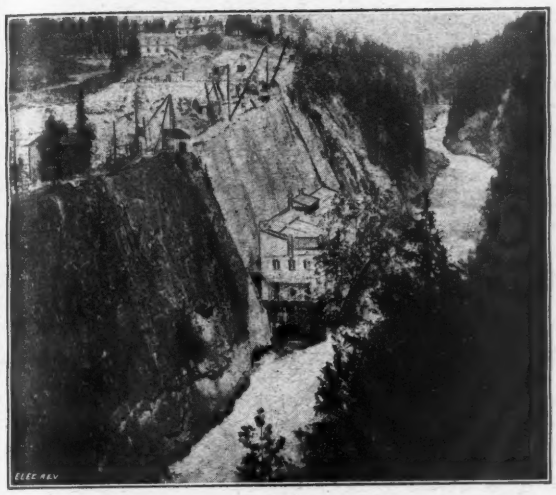


Fig 1.—Hydro-Electric Station for Notodden Works

nitrogen from the atmospheric air by means of electricity and combining it with lime, to produce nitrate of lime, a valuable fertiliser. The exploitation of this process is dependent upon cheap power being available, and such power was to be found in the Norwegian waterfalls.

After the necessary experiments with the process had been completed and the rights of several important waterfalls had been secured, it was decided to erect the above works at Notodden in connection with the harnessing of Svalgfos, situated at a distance of about 3½ miles from the works. This waterfall is on the river Skienselv, which is formed by a large number of rivers and lakes, the complete regulation of which will allow 1,700 million cubic metres of water to be stored annually in the autumn for the benefit of the numerous manufactories and mills in this "black country" of Norway.

In the Tinnelv, the minimum supply of water will never be less than about 90 cubic metres per second, and the works at the Svalgfos have been based on this figure, by means of which 40,000 h.p. will be available. This has been effected by damming the lake of Tinsjo, which is now capable of holding 220 million cubic metres of water; the dam was constructed with the express view of increasing this quantity, when the Rjukan waterfalls have been harnessed, representing two power stations of 240,000 h.p. The construction of this dam was a very difficult task, owing to various adverse conditions, but was successfully carried out during the winters of 1905-6 and 1906-7.

In order to be able to regulate the supply of water, a basin for distribution purposes has been constructed, to which the water flows by way of a cut in the rocks, 5 metres wide at the bottom. The area of this basin, constructed of concrete, is 1,015 sq. m. and the depth 67 m. The intake to the four turbines is divided into four chambers, each of which can be shut off by means of three sluice gates.

From the distribution basin two shafts lead to the power station, first in an almost vertical direction and then nearly horizontal. Through each of these shafts are led two iron pipes, connecting each of the above chambers with the corresponding turbine. The thickness of these pipes is 4 mm. at the top and 16 mm. at the bottom, while the internal diameter is 3·40 m.

The power station (figs. 1, 2 and 3) is 56 m. long, of which length, some 7 m. is occupied by the switch room, while the width is 11 m. The building has been erected in the river bed, and the foundation forms a single block of concrete, resting against the steep flank of the mountain. On account of the limited area of the site there was only left a space of about 12 m. in the length for each turbine, for which reason the whole arrangement had to be concentrated as much as possible. The power house is built of brick, and an iron construction carries the roof.

The difference between the level of the intake at the bottom of the distribution basin and that of the turbine shafts is 35·9 m., and the latter are placed 1 m. above the floor. The turbines and generators were supplied by the firm J. M. Voith, of Heidenheim, whose tender seemed to

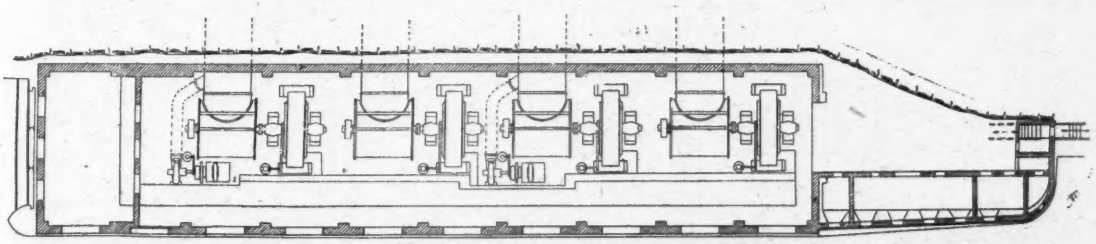


Fig. 2.—Plan of the Notodden Hydro-Electric Plant.

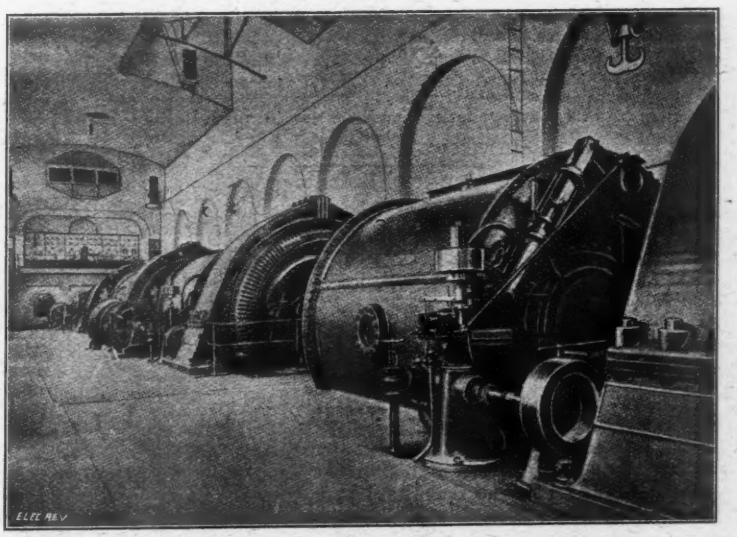


Fig. 3.—The Interior of the Power Station.

offer many advantages in regard to the constructional arrangements, apart from its being the cheapest. The construction is shown in fig. 4. The transverse section of the nozzle measures 4 m., and the nozzle is not divided.

The turbine and the generator are coupled direct, and

* Abstracted from *Teknisk Ugeblad*

have in all three bearings, furnished with the necessary lubricating apparatus and water-cooled in addition.

The shafts are forged from Siemens-Martin steel, and the fly-wheels, 1·5 metres in diameter, are made of steel with vanes, which at the entrance have a width of 325 millimetres. The total weight of the shaft and the runners is 9,000 kg. The covers of the nozzles and the upper part of the discharge pipe were divided, in order to facilitate the work of installation.

In the centre of the supply pipe is placed a strong vertical partition, partly for support and partly with the view of directing the water to the vanes better.

The vanes are made of cast-steel of the well-known Voith construction, and are adjusted by a regulating shaft situated above by means of rings made of cast-steel. This shaft is worked by a servo-motor cylinder fitted on the cover of the nozzle.

The governor and regulating apparatus are fixed in front of the turbines. The governor runs at 450 R.P.M., and the amplitude of its oscillation is 70 mm. On each governor is an electrically-driven apparatus showing the speed.

The oil pumps, which are single-acting, are placed behind the turbines, and run at a speed of 250 R.P.M., which gives a supply of 50 litres of oil per minute under a pressure of 15 atmospheres. All the oil pipes are connected so that any of the pumps can be made to serve as a substitute for the others, and this applies to a fifth pump in reserve, driven by a small electro-motor quite independently from the turbines in the power station.

The contractors had guaranteed that the turbines at the given height of the fall and fully loaded, should yield 10,000 H.P. at 250 R.P.M., and with an efficiency of 78 per cent.; at three-quarter load, 7,800 H.P. with an efficiency of 81 per cent.: and at the maximum height of the fall, 40 metres, at full load, with an efficiency of 76 per cent., 7,650 H.P. The pressure in the pipe on the same level as the turbine shaft was not to exceed 50 per cent. of the full pressure, when the turbine was unloaded. The turbines were tested in October, 1907, and proved to work satisfactorily in every respect.

The generators were made by the Allmänna Svenska Elektriska Aktiebolaget, of Vesteras, in Sweden, and are

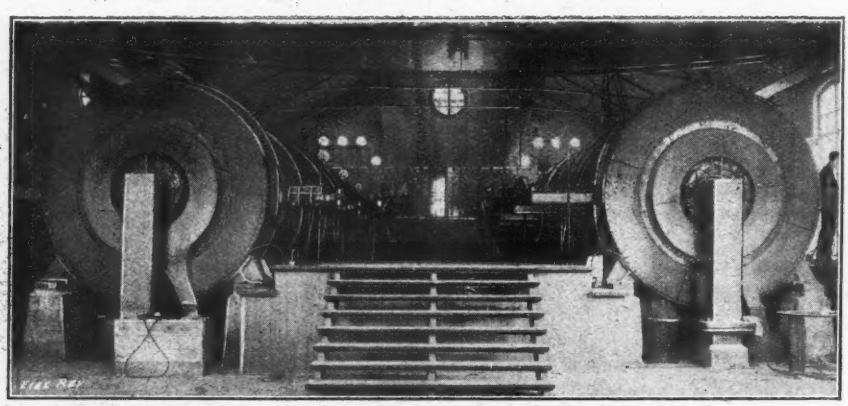


Fig. 5.—The Furnace House, Notodden.

three-phase machines running at 50 cycles per second, 600 amperes pe phase, and 10,000 volts. Normally, they generate 10,500 KW., which corresponds to a power factor of 0·67 on the basis of an output from the turbine of 10,500 H.P.

The lamnations, insulated by means of paper, are divided into a number of sections with wide channels between for ventilating purposes. The armature coils, placed in open slots, consist of wound spools in three planes. The armature slots number three per pole and phase, and the pole-shoes, which are laminated, are divided into sections corresponding to the sections of the armature core.

The magnetic field is made from soft cast-steel with poles and yoke cast in one piece, which, however, has been divided in order to facilitate the casting and especially the transport. The magnet system is carried on a cast-steel spider with eight arms of hollow and oval section. The shaft is forged from the best Swedish steel; the length of the journals is 1,000 mm. and the diameter 350 mm. In the bearing caps are cast-steel pipes, through which the cooling water circulates. Measured with water cooling, the maximum temperature was 30° C. and without 50° C. Outside the bearings, on an extension of the shaft, are the collector rings, made of cast-steel.

The efficiency of the generators, including all mechanical losses, amounts to about 95 per cent., equal to an efficiency

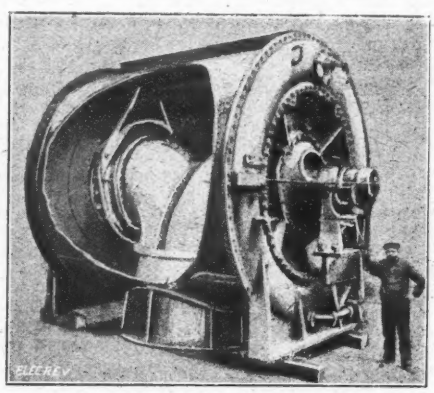


Fig. 4.—Voith Turbine, showing Interior.

of 97 per cent. with unity power factor; the loss therefore amounts to 500 H.P., which is equal to an emission of heat of 320,000 kg. cal. per hour.

Good ventilation, therefore, is necessary, and for this purpose fans are arranged, which force cool air through channels in the floor to various pits, whence the air is forced through special cast-iron ducts into the magnet system, which, again, acting as a fan, forces the air through the heated parts of the armature. The gross weight of each generator is 105 tons.

The switchboard and controlling apparatus, &c., has been delivered by the Norsk Aktieselskap Siemens-Schuckert, of Christiania.

The energy required for the excitation of the generators is supplied by two shunt dynamos, working in parallel. Each dynamo separately is capable of supplying excitation for all four generators, and is direct coupled to a special turbine, having a capacity of 350 KW. at 220 volts and 700 R.P.M. In order to avoid sparking, whatever the load may be, the exciters are fitted with commutating poles, and have two commutators. The speed is regulated in the same manner as for the main turbines, viz., by means of a small electromotor connected with the turbine governor, and controlled by a switch on the board.

The generators, exciters and switchboard are coupled by means of lead-covered cables running through channels in the floor.

The switchboard is divided into three storeys, and special importance has been attached to the attainment of the greatest possible working independence of the apparatus, machines and cables. The arrangement has been carried out in such a way that all four generators work in parallel on a system of bus-bars, which are connected with Notodden by three cables.

In the first story of the switch room, on a level with the floor, are arranged brick cells for the seven three-pole maximum oil circuit-breakers, viz., one for each generator and one for each cable. These cells are again partitioned into fireproof compartments, each of which contains one phase; each switch unit thus consists of three single-pole oil-break switches, worked by electromagnets.

The apparatus used for this purpose is also fireproof, and consists of two electromagnets, the larger for switching off the current and the smaller for switching on. The latter is connected with the switchboard, and the current for both is supplied from the exciters. In order to control the position of the switches there are various coloured signal-lamps on the switchboard showing whether the respective circuits are switched off or not.

In the first story of the switch room also are all the measuring transformers and the choking coils for the protection of the generators, as well as a water-jet earthing device.

In the second story is a gallery, from which the engine room can be overlooked, where the switchboard is installed. This board is divided into marble panels, one for each generator, one for the exciters, and one for the receiving apparatus and transmission cables.

Each generator is provided with ammeters for each phase, voltmeters with switches, wattmeters for phases unequally loaded, and ammeters for the field current. There are also switches for regulating the speed of the machines and for working the large oil circuit-breakers with their signal lamps, as well as hand-wheels for regulating the exciting current.

In the room behind the switchboards the high-tension bus-bars are fixed to a special frame, separated by fire-proof brick walls from the low-tension part of the plant. There is, further, a testing device by means of which the insulation of the system from earth can be controlled.

In the third story are the resistances for the exciting circuits and lightning arresters. Horn-type lightning arresters are used in connection with oil resistances for the purpose of reducing the discharge passing through the arresters.

The power station is connected with the factories at Notodden by cables, each having a cross-section of 120 mm^2. The power passes through oil-cooled transformers, and is led through an inductance coil before it is admitted to the electric furnaces.

The furnace house, fig. 5, is a building with a floor area of about 21,500 sq. ft. constructed entirely of brick and iron. The number of furnaces is 36, and the construction is shown in fig. 5. The diameter varies from 6 to 8 ft., but the length is comparatively small. The electrodes are placed in the centre of the furnace, diametrically opposite each other, and between them the electric arc is formed. The air is conveyed to the interior of the furnace through the walls of the chamber, which is made of firebricks, and from this chamber the nitrous gases pass through a fireproof channel. The temperature of the chamber is generally about 3,500° C., while that of the escaping gases varies from 800° to 1,000° C. The furnaces can be kept going for weeks without interruption; the brickwork lasts from four to six months, while the electrodes have to be changed every three or four weeks.

The necessary supply of air is obtained by means of centrifugal fans. The gases from the furnaces are collected and conveyed through two large pipes, each with a diameter of 6 ft., to the boiler house, where the heat contained in them is utilised for various purposes.

From the furnace-house the gases pass to a cooling house through large pipes of aluminium, placed in flowing water, and having been sufficiently cooled, pass on to vertical iron cylinders, lined with acid-proof stone, where the oxidation takes place.

Then follows the absorption process, which is carried out in granite towers filled with crushed quartz, through which the gases are forced by centrifugal fans. Passing from the bottom of one tower through the quartz to the top of the second and then downwards, and so on, the nitrous acid combines with the water, which is the main object of the whole process.

While the gases are passing through the row of towers, water is allowed to drip through the quartz in the towers, and is gradually converted into weak nitric acid. The gases also are conveyed through wooden towers, where nitrate of soda is formed.

The liquid acid from the bottom of the granite towers is collected in a great cistern, from which it runs into "montejus," by which it is pumped up, in order to pass through the towers repeatedly until it has obtained the necessary strength.

The final absorption takes place in the wooden towers owing to the great absorbing power of soda, and the total result of the whole process is that 97 per cent. of the nitrogen contained in the air is extracted. The nitric acid from the towers is collected in a granite cistern, from which it passes to the "dissolving works," consisting of granite vats filled with limestone, over which nitric acid is poured. The product becomes calcium nitrate, a liquid solution, which is pumped up into vacuum evaporating pans. When the liquid gains a strength of 13 per cent. of nitrogen at a given temperature, it is further conveyed to the solidification chambers, where it stiffens into a crystalline and brittle mass, hard as stone; this is crushed, and in this form represents the finished product, which is sold in casks weighing 2 cwt.

The final product from the soda towers is the nitrate, which is obtained after having been purified from other constituents with which it was combined. It then is crystallised, dried in hot air, and packed in casks of 660 lb. each for export. The nitrite of soda produced in this way is used in the manufacture of certain aniline dyes.

The nitrate of lime is also used in the chemical trade for various purposes, but its chief use is as a substitute for natural manure, and its value for fertilising purposes is quite equal to that of nitrate of soda from Chile, and in certain cases even superior. The Norwegian nitrate of lime has been practically tested in most European countries with such satisfactory results, that whatever the production in the future may be, there will be no difficulty in disposing of it.

The Notodden factory is the first of its kind, but there are several others in course of erection, as well as factories on other lines, which are going to be put into regular work as soon as the harnessing of the large waterfalls, which the company or the combine have secured, is completed.

The total capital which has been spent, and is to be spent, on the projected new buildings and extensions, amounts to about 3½ millions sterling. The company's representative in England is Mr. J. J. Beer, 15, Cullum Street, London, E.C.

The production at Notodden during the first year amounted to 20,000 tons of nitrate of lime, but when all the projected works have been completed, the minimum production will be 100,000 tons per year.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

National Electric Construction Co., Ltd., and Canterbury Corporation.

My attention has been called to a paragraph which appeared in your paper on the 16th inst. with reference to this case. The statements made are so inaccurate that I feel it necessary to write and put the correct position of the matter before you.

My company entered into an agreement, in the year 1898, with the Canterbury Corporation, under which they undertook to install, free of charge, wiring in consumers' premises in Canterbury, so that the Corporation would get them as customers for their supply of electricity.

In consideration for this expenditure, the Corporation undertook that, whether they received any sum or not from the consumer, they would pay a minimum sum to my company in respect of such installations. In certain cases where the Corporation said that they did not receive a payment in respect of such installations from the consumer. they declined to pay the amount to the company, and we consequently brought an action to recover such sums.

There is no question that under the construction of the agreement the Corporation were liable to pay such sums, and, notwithstanding the benefits they have derived from the expenditure of capital by my company, they took the point that the agreement on this point was *ultra vires* on the part of the Corporation, and the County Court Judge so held. We are advised by eminent counsel that that decision is wrong, but, having regard to the small amount at stake in this particular case, we decided that it was not worth while pursuing the matter further, for the moment.

The Corporation's action, to use a sporting phrase, is not what one would call "playing the game." Here, we have a Corporation entering into an agreement, on the advice, no doubt, of the Town Clerk, and, after undoubtedly having received substantial benefit from the agreement, they apparently think it straightforward dealing to evade their obligations by a pure technicality, and deprive my company of the payment of sums to which they were justly entitled in return for the capital expenditure to which they were put in assisting the Canterbury Corporation to extend their system of supply.

So much for the merits of the case. We will leave yourself and the public to judge as to the fairness, or otherwise, of the way in which our company has been treated by this Corporation.

In the second place, your paragraph states that the whole agreement was held to be void, and that consequently the decision will apparently affect, without distinction, all existing cases in the city where the company have wired houses under agreement. This is wholly incorrect; it was merely the one provision by which the Corporation agreed to pay a minimum sum, even where they did not receive it from the consumer, that was held by the County Court Judge to be void. In cases where the Corporation is receiving payment from the consumers for the installations they are, of course, bound, and will remain bound, to hand it over to my company as and when received.

In conclusion, I would express the opinion that few, if any, local authorities, in a country where honourable dealing is expected, would have acted in a similar manner.

I shall be obliged if you will kindly insert this letter in your next issue, in order that the erroneous impressions created by your paragraph may be removed, as the matter is, of course, one of importance to my company.

W. B. Cownie,

General Manager and Secretary,
National Electric Construction Co., Ltd.

Tata Hydro-electric Power Co.

In the "Lighting and Power Notes" of your issue of the 9th inst. you quote from the *Indian Textile Journal* with reference to the Tata Hydro-Electric Power Co.'s installation, for which our Mr. Alfred Dickinson is consulting engineer.

We beg to state that no contract whatever has been made for the electrical plant, and the company are perfectly free.

We should be glad if you would give this similar publicity.

Alfred Dickinson & Co.

Birmingham, *December 23rd*, 1910.

International Language and Science.

I have read with interest the review (which appeared in your last issue) of the above book, and as there are several misleading statements, I hope you will give me a little space to clear up the points.

The International Commission was appointed to consider the question in general, and not to invent a new language. They reported in favour of Esperanto, but said some modifications were desirable. After this a certain member of the Commission brought forward a slightly modified Esperanto called Ido. I will not deal more fully with its birth as the circumstances were—well, to put it very mildly—regrettable. Ido is now put forward as the suggestion of the Commission, whereas the facts are that, in the first place, the Commission had no mandate to suggest any modifications of the languages submitted to them, and secondly, Ido was never considered by the Commission as a whole. The President, Prof. W. Förster, even went so far as to resign as a protest against the introduction of the so-called "improved" Esperanto.

I have no wish to enter into the general question of Esperanto, and Ido, but I must say that the latter is too logical to be used by any but experienced grammarians.

On the other hand, Esperanto has now passed the stage of seven International Congresses, and has stood all possible tests. I have personally found it suitable for all work, from technical articles to ordinary daily conversation. It is well supported by some of the greatest scientists and commercial houses in this and other countries.

In conclusion, I may say that it is now too late to talk of another international language, for Esperanto holds the field. Its displacement by another language is impossible; but if for unforeseen reasons it should fail to attain full success, such failure would be a death-blow to Ido and its other imitations.

F. Peake-Sexton.

Kingston-on-Thames,
December 26th, 1910.

[The statements referred to are not the reviewer's. Regarding the merits of rival new languages, we foresee the possibility of an endless correspondence, and therefore, while we have pleasure in publishing this letter, we are unable to accept any further communications on the subject. —Eds. E.R.]

RECENT DEVELOPMENTS IN TEXTILE MILL DESIGN AND OPERATION: NOTABLY AS REGARDS ELECTRIFICATION.

By L. CROUCH.

(*Concluded from page* 1015.)

Royal Weaving Co.—Darlington Mill.

This mill, containing 600 looms, is being enlarged by the addition of more than 1,000 looms and by the erection of a small dyehouse. At the time of writing the extensions are not completed, though much of the plant is already electrically operated. As is usual, the looms are driven individually, ½-H.P. 220-volt three-phase 60-cycle squirrel-cage motors being employed, as shown in the accompanying illustration. The spinning departments are group-driven by 550-volt three-phase 60-cycle motors. "Home" generation of electrical energy was decided upon in this instance, owing to:—

1. The necessity of providing a considerable quantity of steam for mill heating and for dyeing processes.

2. The lower cost of home generation as compared with purchased supply.

Buildings.—These are of red brick, but reinforced concrete also figures largely in their construction.

Power House contains the turbo-generator room (64 ft. × 98 ft.) with a basement 14 ft. deep. The walls of the turbine room are faced with enamelled brick to a height of 6 ft. 6 in.: the floor is of reinforced concrete slabs laid on a steel frame and covered with red vitrified tiles: the roof is of reinforced cinder concrete laid on steel trusses and girders, and covered with tar and gravel. A 15-ton hand-operated travelling crane serves the turbine room. The basement is floored with granolithic concrete.

Boiler House.—47 ft. × 93 ft.—lies to the rear of, and adjoins, the power house. The floor is of vitrified brick on a concrete base, and is level with the basement of the power house.

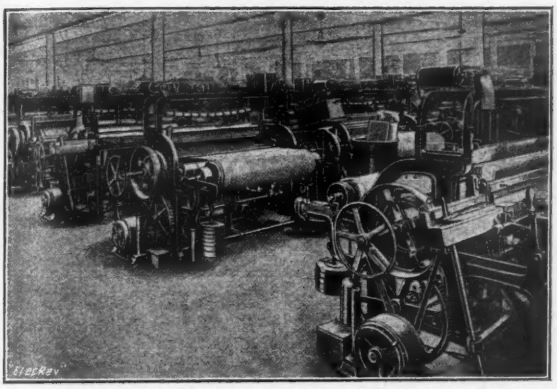
Smoke Stack is 175 ft. high above the boiler house floor, and has an 8-ft. diameter flue.

Equipment.—Boilers.—Four Babcock & Wilcox boilers fitted with Foster superheaters supply steam at 175 lb. per sq. in., with 125° F. superheat (measured at the throttle).

Turbo-Alternators.—Three 500-KW. horizontal turbines drive 550-volt, three-phase, 60-cycle 750-K.V.A. generators at 3,600 R.P.M. Owing to the small horse-power of the loom motors, the overall P.F. of the mill is only about 70 per cent., hence the large capacity of the alternators as compared with that of the turbines driving them. Sufficient space is available for the installation of another generating unit equal to, or larger than, the existing sets, two spare boiler beds being also provided to meet such an extension.

Exciters.—One 50-KW. 120-volt D.C. generator is direct-coupled to a small steam turbine, while another similar machine of 55-KW. capacity is driven by a 60-cycle three-phase induction-motor.

Condensers.—Three jet-type condensers are provided (each direct-driven by a 10-in. × 12-in. engine). Two parallel concrete trenches run the whole length of the power house basement; into one of these the condensers discharge, and the hot water flows to the hot well. From the latter, two



INDIVIDUAL DRIVING AT DARLINGTON MILL.

10-in. double-suction horizontal shaft centrifugal pumps (each direct-coupled to an 8-in. × 9-in., 350 R.P.M. engine) lift the water to the top of the cooling towers. The cooled water is discharged into the second concrete trench, and is re-used.

Cooling Towers.—Four of the double-fan type are provided; each will lower the temperature of 430 gallons of water per minute from 105° to 85° F., assuming an air temperature not higher than 70° F., and a relative humidity not exceeding 70 per cent.

Pumps.—All the steam-driven pumps employ steam at 175 lb. pressure, 125° F. superheat. Of two pumps used in the hot water mill-heating system, one is motor-driven and one turbine-driven. The two boiler-feed pumps are of the duplex, plunger, pot valve type (size 12 in. × 7 in. × 12 in.), a domestic service, engine-driven pump of the duplex, horizontal piston type (size 10 in. × 6 in. × 12 in.) is also provided.

Feed Heater.—Of the open Webster pattern, heats 60,000 lb. per hour from 40° F. to within 5° F. of the temperature of the exhaust steam entering the heater.

Water Supply is from the city mains or from artesian wells, according to necessity and convenience.

Switchboard. — The main switchboard is of blue Vermont marble, and has 15 panels, of which three contain the exciter switchgear and voltage regulator, three contain the alternator switchgear, one controls the station lighting and carries the frequency and power factor meters and the earth detector, six control the various lighting and power feeders, and, of two spares, one is for a future alternator and one for feeder extensions.

The alternator panels each contain three ammeters, indicating and integrating wattmeters, the necessary control switches and rheostat mountings and one non-automatic oil switch.

The feeder panels each include an ammeter, indicating wattmeter and automatic oil switch with time relay.

Oil switches are mounted on the wall, clear of the board; bus-bars are carried on a frame above the switches and instrument transformers are mounted in the basement with the exception of those for the alternators which are mounted inside the generator foundation. Lead-sheathed cables pass straight from the instrument transformers into conduits beneath the basement floor. No pressure higher than 110 volts is taken on to the switchboard.

Operating Notes.—The turbines are supplied with steam at 175 lb. pressure and 125° F. superheat, and exhaust to the condensers, or, if necessary, through relief valves to the atmosphere. All auxiliary engines are fed at the same pressure and temperature, and their common exhaust is led to the feed heater, to the mill-heating system, or to atmosphere at will. When the low pressure steam supply is insufficient for heating purposes, live boiler steam is also supplied, through a thermostatic valve. The boiler feed is drawn from the feed-heater or from the city supply or artesian wells, or partly from one source and partly from another; hot and cold feeds can also be mixed and delivered uniformly, or some boilers fed with hot and some with cold water.

Efficiency.—The guaranteed efficiency, as yet unchecked by test, is 46,000 B.TH.U. per KW.-hour output, measured at the switchboard terminals, *i.e.*, 7·4 per cent. overall efficiency (coal to supply mains). This guarantee presumes the plant to operate at its rated capacity 1,500 KW. with 100 per cent. load factor and power factor (a water load); the mill-heating plant is not to be considered in this test, and the B.TH.U. used is to be taken = lb. coal × average cal. val. of coal as used.

NEW WEAVING SHED.—WHITMAN MILLS, NEW BEDFORD, MASS.

This shed, when complete, will be one of the largest in the world, covering an area of 360 ft. × 550 ft., and containing 3,400 looms (= 58 sq. ft. per loom). The output will be specially fine silk and cotton goods.

The building is of one story only, has brick walls and a "saw-tooth" roof, carried on hard pine columns. A double floor of hard pine and maple (on top) is carried by steel beams, these being much cheaper than suitable hard pine beams.

A 2,000-KW. turbo-generator supplies six 150-H.P. motors which operate the various groups of machines through group shafting placed wholly under the floors, to avoid belt obstruction to lighting and ventilation. Overhead steam heating is adopted in conjunction with the Cramer moistening system, and a Grinnell sprinkler equipment guards against fire dangers.

MODEL NASHAWENA MILL.

This is one of the five large Whitman mills of New Bedford, Mass. Three of this group have been inaugurated during the last year, and represent an investment of over £1,200,000. This formidable trio includes the present mill, the Nonquit No. 2 mill (New Bedford), and the worsted spinning mills at Arlington, Lawrence, Mass. A large yarn finishing and mercerising mill is being added to the latter.

The Nashawena plant is believed to comprise the largest cotton mill ever installed at one time, and to contain the largest weaving shed in the world. The construction of the main mill only departs from standard practice in so far as is necessitated by the specially fine material handled, and by the large size of the mill. The latter has led to the use of steel instead of hard pine floor beams (though wooden columns are still chiefly employed), and to the narrowing of the window pilasters to 25 in. only, so that *no less than 80 per cent. of the side structure is glass.* Concrete foundations are used. In spite of, or perhaps because of, the many improvements effected in construction and arrangement of the mill buildings, the capital cost per spindle has remained quite normal: the use of steel beams effected an economy which went far towards compensating for increased expenditure on other items.

By using three-layer flooring, the top layer, of 1-in. maple, being laid parallel to the bottom, longitudinal heavy pine flooring, only one bay of the shed is interfered with at any one time during subsequent floor renewals—a great advantage over transverse top flooring. A plank pine roof is covered with tar and gravel.

The weaving shed is very similar to the main mill, except that the lighting is almost wholly overhead, so as to avoid the tendency of side windows to throw shadows.

The sanitary provisions in this, as in most recent American textile mills, are very thorough. Salt water is used to cleanse

the toilet rooms, avowedly on account of its deodorising properties, but probably actually on account of its being the cheapest available supply. (The Acushnet River supplies salt water for this purpose as well as for condensing, &c., in the power and boiler houses.)

Size of Textile Buildings.—Main shed, four stories, 800 ft. long, 135 ft. broad ; weaving sheds, one story, 800 ft. long, 285 ft. broad ; basement, 14 ft. deep, 80 ft. wide, 800 ft. long ; store-house, 2 stories, 100 ft. × 300 ft.

Power Buildings.—The boiler house and engine room are in a separate building near the Acushnet River (see above) ; they are on the opposite side of the avenue to the textile buildings. A communicating tunnel has therefore been built under the roadway to convey steam and water pipes and electric cables.

The boiler house contains 16 Manning boilers, hand-fired, and discharging into a 250-ft. reinforced concrete stack. The engine-house contains two 3,000-KW. three-phase 600-volt Allis-Chalmers turbo-generators with the necessary condensers, and one 500-KW. direct-current 220-volt generator supplying the lighting circuits and the machine shop, besides sundry auxiliary machines. Ten electrically-driven vacuum pumps are provided. The pump room occupies the remainder of the power buildings. The textile machinery is electrically driven throughout, mainly in small groups, by three-phase 600-volt induction motors; 150,000 spindles and 5,000 looms are so operated.

The Nashawena mill is connected with other mills of the Whitman group so far as concerns fire protection ; in the event of an outbreak the collective output of seven pumps, each of 1,500 gallons per minute capacity, is immediately available.

The above notes illustrate recent American practice in the conversion of mills to electric driving as well as in the installation of new equipments on this system. The vigour with which the electrification of textile mills is proceeding on a large scale in America should give further impetus, if such be required, to similar work in British mills

LEGAL.

Scarborough Tramways Co., Ltd.

At the Scarborough Police Court on Wednesday, December 21st, the Deputy Town Clerk (Mr. S. Jones) was granted a summons, returnable on January 11th, against the above company, under Sec. 92 of the Tramways Act, 1902, for having failed to comply with an order to provide such service of cars as might reasonably be required in the public interests, having regard to the population and requirements of the locality and other circumstances. It was stated that the company was liable to a penalty of £5 for every day the cars ceased running. The cars ceased running on October 31st for the winter months, and the Corporation appealed to the Board of Trade, who, after holding a public inquiry, gave their award on November 19th that a limited service of cars should be run. On November 25th the borough Justices granted an application on behalf of the Edmundson's Electricity Corporation, Ltd., for the appointment of a receiver of the tolls and dues of the Tramways Co., owing to the latter's indebtedness to the former.

At the Court on Wednesday last week the Deputy Town Clerk said he was claiming from November 22nd to December 21st.

The Magistrate's Clerk : We must face the chance of their not putting in an appearance, because it is common ground that the cars are not running. Have you a resolution of the Town Council ?

Mr. Jones : I am prosecuting in my own name. I do not think the Corporation can be informants.

The Marconi Patent Case.

(*Continued from page* 1021.)

On the resumption of the case on Tuesday, December 20th, Mr. John Pletts was called for the plaintiffs. Examined by Mr. Walter, he said that he was an electrical engineer, and had devoted himself to electricity and its application to wireless telegraphy for the last dozen years. He was responsible for the installation of some of the original Marconi practical workings, and he superintended the erection of an installation of five stations at the Sandwich Islands.

Were those wireless installations, installations in which the invention of 1900 was used ?—They were not.

Where those installations in which the 1896 invention was used ?—Yes. The mean distance obtained at those stations was about 20 miles. The maximum was about 70, but the 70-mile distance did not give satisfactory results. Seventy miles at that time was practically the limit. He also erected stations at Chateau Bay, Labrador, and Belle Isle. They were not fitted with the 1900 invention. In 1903 he erected a station in Portuguese West Africa, and that did have the 1900 invention. They had, however, still the old coherer. Immediately after the introduction of the 1900 invention, the limit of distance increased, and very soon a distance of 120 miles was obtained. He also erected a large number of wireless stations in Russia during the Russo-Japanese war. They had now accomplished a distance of nearly 6,000 miles. In all the greater distances the device in the 1900 patent had been used. He had made himself acquainted with all the literature in the case, and he had heard the evidence of Mr. Swinburne and Mr. Dugald Clerk.

As an electrical engineer principally devoted to wireless, do you agree with the evidence given by these witnesses ?—I do.

With all the information contained in the papers to which attention has been called, is there anything prior to the 7,777 patent that would have told you the plaintiffs' invention of 1900 ?—Certainly not.

Was the 1900 invention new or old ?—New.

Cross-examined by Mr. Terrell, Witness said that, in 1900 or 1901, the greatest distance obtainable was about 150 miles. After that, the distances were greatly increased.

After the invention of 1900, many inventions were made in wireless ?—Yes.

And they have been continuous up to the present time ?—Yes.

These inventions have gone on giving greater and greater distances ?—Some of them have.

The greater the power the greater the distance ?—Greater energy was a factor in getting greater distances ; greater sensitiveness of the detector was also a factor.

You have had great changes in the detector ?—Yes. In 1900 they had not the delicate detectors they had now.

What detectors were used for obtaining a distance of 600 miles ? Magnetic, or a valve.

Do you use light ?—Witness said he did not know that, but detectors were used that might record by light.

Were the points of improvement in the transformer, the detector, or both ?—Both. He was employed by the plaintiff company, and had not done any wireless except in the employ of the plaintiff company.

The evidence of this witness concluded the case for the plaintiffs so far as the 1900 patent was concerned.

Mr. Walter proceeded to sum up the plaintiffs' case. He said that Tesla never contemplated any condition of resonance between his working circuit and his discharge circuit. He never thought of tuning the one with the other, and at that time it was quite impossible to do it. Any difference made from Tesla by Lodge was made by Marconi in the first instance, and Lodge then went back to another form of telegraphy that was not Hertzian wave at all. They had heard the evidence of Mr. Pletts as to the enormous increase of distance by the introduction of the 1900 patent, and that was brought about by the combination of a good radiator with a good oscillator. It sounded simple now, but it was new to everybody until Marconi came upon the scene. With regard to infringement, it all depended upon what glasses you looked at it through, but his contention was that the two instruments were practically identical. The plaintiffs' was an invention of the highest merit, and one by which the world at large had been enriched. That, he submitted, was proof of subject matter, and he asked the Court to say that, the defendants having taken the plaintiffs' combination, they were entitled to relief.

In opening the case for the defence, Mr. Terrell said that it was a case in which it was impossible for anyone who had not made a life-long study of electricity to be quite satisfied that he could put before the Court the complexities of the action. He came before the Court as a person who was crammed and who was unable to combat the witnesses who had been called, and he was not at all sure that he could make all the points clear that he wished to make there. A natural prejudice must exist in every Court in bringing an action coupled with such a great name as that of Mr. Marconi. It was a prejudice that he could not get over ; but still, he ventured to submit that it was a case that should be considered on its real merits as a case between two unknown persons, and the case he was going to present to the Court, he ventured to submit, was one of overwhelming force. The three issues he desired to put to the Court were :—(1) Under the true construction of the Marconi patents have the defendants infringed ? (2) is the patent anticipated by Braun, having regard to what the defendants say they are entitled to read into Braun, as being common knowledge ? (3) having regard to the common knowledge of the time, is there subject matter in taking Braun in addition to some of the common knowledge ? He proposed, first of all, to deal with infringement. He put it alternatively : first, he said that upon the true construction of the plaintiffs' claim a transformer was the essence of the plaintiffs' patent, and if they had not taken that transformer they had not infringed. Then they said alternatively that Marconi had, strictly speaking, described nothing in his specification but a two-coil transformer, and if that was so, on the authority of the Nobel case, all auto-transformers being well known according to the language of the claim, it was excluded from the claim. That was how he put the issue of infringement.

Counsel proceeded to deal at length with authorities, but a difference of opinion arising between counsel as to the exact meaning of certain diagrams, Mr. Swinburne went back into the witness box to give an explanation. At the conclusion, Mr. Terrell remarked

that it seemed that the more complex a thing was the better chance it stood of getting home.

Continuing his opening of the defence on the following day, MR. TERRELL contended that in the mouths of Mr. Swinburne and Mr. Dugald Clerk the word transformer had changed its meaning since the commencement of the case. They had come into Court to prove that the defendants had an auto-transformer in the shape of a loose coil with two parts which acted *inter se* to convey energy from one to the other in the same way as the transformer did. The auto-transformer seemed to him to be the nest egg of the plaintiffs' case. Counsel proceeded to read at great length the evidence given by the plaintiffs' witnesses, and Mr. Justice Parker asked whether he was reading it because he agreed with it, or because he did not agree with it. Counsel said he was reading it because he did not agree with it. He was reading it to show what the witnesses apparently meant by an auto-transformer. The invariable meaning was something that induced a current from one part of a circuit to another part of a circuit. Mr. Swinburne, as he understood him, said it was a transformer, because it had an induction effect, but his argument was that you could not call anything a transformer at all unless its action was to cut the lines of force created by the magnetic field of a current.

With the permission of his LORDSHIP, MR. DUDDELL, who is to give evidence for the defence, went on to the Bench to explain the more technical parts of counsel's argument.

COUNSEL submitted that if they eliminated the transformer, then the defendants did not infringe, and if they sought to catch him on the doctrine of electrical equivalents, then he said the equivalent was not known at the date of Marconi's invention. That was to say, such an instrument as was described in the specification had never been used for transferring energy from one place to another. There was no evidence that any one had ever used an auto-transformer—he would not, however, say an auto-transformer, because it was not really an auto-transformer—but an instrument of this kind for the purpose. Perhaps some day they would learn what a transformer really meant, but he contended that what was called a transformer in the plaintiffs' claim was not a transformer at all.

MR. ASTBURY: Mr. Swinburne tells me that you are using an iron-core transformer in your receiver, and it is working.

MR. TERRELL: You will agree that there are transformers that won't work.

MR. ASTBURY: You can get anything not to work, but an iron-core transformer will work.

MR. TERRELL said that was all the evidence he desired to read with regard to transformers, and he would now come to the question of what was a "shunt." That brought him to this—first of all, the Court had to decide what was common knowledge at the date of Marconi's specification. The anticipations pleaded were not specifications dug up from the Patent Office, of obscure inventors, but they were the records of knowledge of princes in the art, such as Dr. Silvanus Thompson, Sir Oliver Lodge, and Mr. Braun. He would satisfy the Court that, at the date of the plaintiffs' specification in 1900, not only were the contents of these specifications known, but they had reached that state of knowledge that became common knowledge. If that was so, to add the contents of those specifications to Braun was not invention. If into Braun they read tuning, they had got all. Tuning was common knowledge, and they must read Braun in the light of common knowledge. The point of Marconi was not tuning, but was dividing his circuits and introducing into the first, capacity. That was his case upon that point.

Counsel had not concluded when the Court rose, and the further hearing was adjourned until next sittings.

RICHARDSON *v.* DUBLIN UNITED TRAMWAY CO.

IN Dublin on the 21st inst., the action of E. N. Richardson, of Summerhill, against the above company, was concluded. Plaintiff's case was that he sustained severe injuries, owing to the horse he was driving, yoked to a trap, falling, on account of the company's tramlines being in a state of disrepair. The company denied negligence, but the jury found for the plaintiff, and assessed the damages at £800. A stay of execution was granted.

THE PHYSICAL SOCIETY'S EXHIBITION.

AS usual, the annual Exhibition of electrical, optical and other physical apparatus organised by the Physical Society of London, which was held at the Imperial College of Science last week, marked the introduction of a number of novel and interesting devices, covering a wide range of applications. We commence below a description of the principal features of the collection of interest to the electrical industry.

CAMBRIDGE SCIENTIFIC INSTRUMENT CO., LTD.

Central station engineers will be interested in the patent Bi-Meter CO_2 Recorder shown by this company, as it works on a new and simple principle—measuring the flue gases before and after the absorption of the carbon dioxide, and recording the difference as a percentage. The accompanying illustration, fig. 1, shows the arrangement of the apparatus, which consists of two meters connected to the recording mechanism by differential gear, an absorption chamber, an aspirator, a soot filter, and the recording drum. The gas passes first through the filter, then through the first meter, the absorption chamber, in which the CO_2 is absorbed by dry lime, and through the second meter to the aspirator, which is operated by water. To ensure that the temperature of the gas shall be the same when passing through both meters, water-cooled equalisers are provided. The record consists of a series of vertical lines on the chart, each representing the percentage of CO_2 absorbed

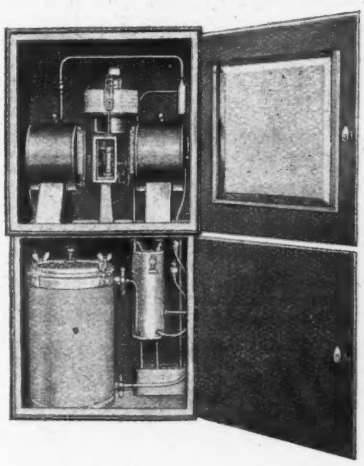


FIG. 1.—BI-METER CO_2 RECORDER.

while a fixed volume of gas is passing through the apparatus; after each analysis the pen drops to zero and starts again. Any number of analyses up to a maximum of 25 can be made per hour, the frequency being regulated by the rate at which the gas is aspirated, and as a definite volume of gas must pass through during each analysis, the accuracy of the records is not affected by any chance obstruction to the flow of gas. There are no glass parts or rubber tube connections, metallic piping being employed throughout, so that the apparatus can safely be used in hot positions and in the tropics; the working of the recorder is smooth and continuous, and the cost of running extremely small, as a pennyworth of lime lasts a month, and the aspirator uses about 2½ gallons of water per hour. The importance of setting a watch on

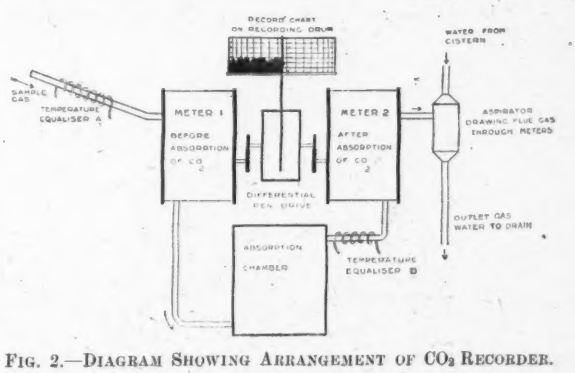


FIG. 2.—DIAGRAM SHOWING ARRANGEMENT OF CO_2 RECORDER.

the percentage of CO_2 in the flue gases, in order to ensure complete combustion of the fuel and to detect air leakage, needs no emphasis nowadays, and this device appears to be particularly efficient to this end.

Peake's patent compensating leads for use with thermo-couples have been introduced by the company for the purpose of transferring the cold junction from the neighbourhood of a furnace to the milli-voltmeter itself, where its temperature can be observed and allowed for. Thus the error due to the use of copper leads, with the cold junction at the pyrometer and at a variable and unknown temperature, is obviated. Another improvement in this connection is the use of a "set-up" temperature recorder; in this device (called the scale-range control board), a fixed E.M.F. is inserted in opposition to that of the thermocouple, so that the readings start at the temperature corresponding to this E.M.F. Thus, instead of reading, say, from 0° to 1,100° C., the range can be limited to 800°—1,100° C., giving a very open scale between those limits. This arrangement was shown working in conjunction with the well-known thread recorder.

A very sensitive recording clinical thermometer of the thermo-electric type was also shown, based on the pattern used by the late Dr. Gamgee; the special feature of this apparatus was the simple thermostat used to maintain the temperature of the "cold-junction" at a constant value, consisting of a heat-insulating

vessel of the "Dewar" type, which contained two coils and a thermostatic relay. The latter consisted of two bimetallic strips, arranged to cut in or out one of the heating coils as the temperature fell or rose, and thus to keep the temperature very near the desired constant value.

The Brearley Recalescence curve tracer is an interesting device for recording cooling curves on a very open and accurate scale, with rectangular co-ordinates connecting time and temperature; the galvanometer scale is fixed over the long recording drum, and the observer simply moves the pencil carriage by means of a screw, so as to keep a pointer in coincidence with the "spot," while the marking pencil is automatically depressed on the chart twice every second. The chart may be 360 mm. long and 300 mm. wide, giving a very open scale.

A very sensitive tilted gold-leaf electrometer was exhibited, based on the design of Mr. C. T. R. Wilson, who, in collaboration with Dr. G. W. C. Kaye, has introduced a number of improvements. A section of the instrument is given in fig. 3, where L is the gold leaf suspended in front of the inclined charge plate P, which can be adjusted by the nut D. By varying the distance of the plate from

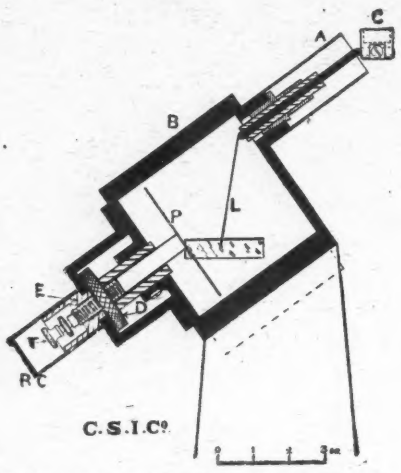


Fig. 3.—Tilted Gold-Leaf Electrometer.

the leaf, the sensitiveness of the apparatus can be adjusted over a wide range, from complete stability over the whole path of the leaf to instability over part of it, and the observer can work as near the intervening point of infinite sensitiveness as may be expedient. Dr. Kaye showed the device in operation, the magnified image of the end of the leaf being projected through the small window upon a screen; the electrification of air bubbled through mercury was thus demonstrated. Ordinarily the plate is maintained at a constant potential, and the movement of the leaf is observed through a microscope.

An Ayrton-Mather galvanometer of high sensitivity was exhibited, giving 740 mm. per micro-ampere at 1 m., with a resistance of 250 ohms and a period of 3 seconds.

Messrs. W. G. Pye & Co.

Amongst the principal features of interest shown by this firm was a new reflecting and indicating galvanometer, in an aluminium case; this is provided with a mirror, giving a sensitivity of 10^{-9} ampere, while a pointer moving over a scale with centre zero, having 50 divisions on each side, gives about three divisions per microampere. The instrument, which is illustrated in fig. 4, is dead-beat, and is provided with an automatic coil arrester. A sensitive reflecting galvanometer, called the "Granta," was also shown, which can be made with a sensitivity of 4×10^{-10}.

Fig. 4.—Combined Mirror and Pointer Galvanometer.

Another noteworthy instrument was a 22-section potentiometer for central station use, arranged in a convenient dial form; the slide wire is protected from injury, and the contacts of all the switches are enclosed on the underside of the ebonite upon which they are mounted (fig. 5). A dial volt-box with a range up to 2,200 volts, and nine ratios from 10 : 1 to 1,000 : 1, as well as "direct" and "off" positions, was shown, and a smaller one for pressures up to 220 volts with 20 equal steps, giving, with 2 volts across the main terminals, pressure steps of 0·1 volt. A number of other resistance boxes, Wheatstone bridges, &c., were also exhibited.

Messrs. Harry W. Cox & Co.

An induction coil and interrupter of new design, with a specially tuned condenser, was shown at this stand, designed to run on a 200-250-volt circuit without additional resistance, the output being controlled entirely by the interrupter; small wireless telegraph sets were also exhibited.

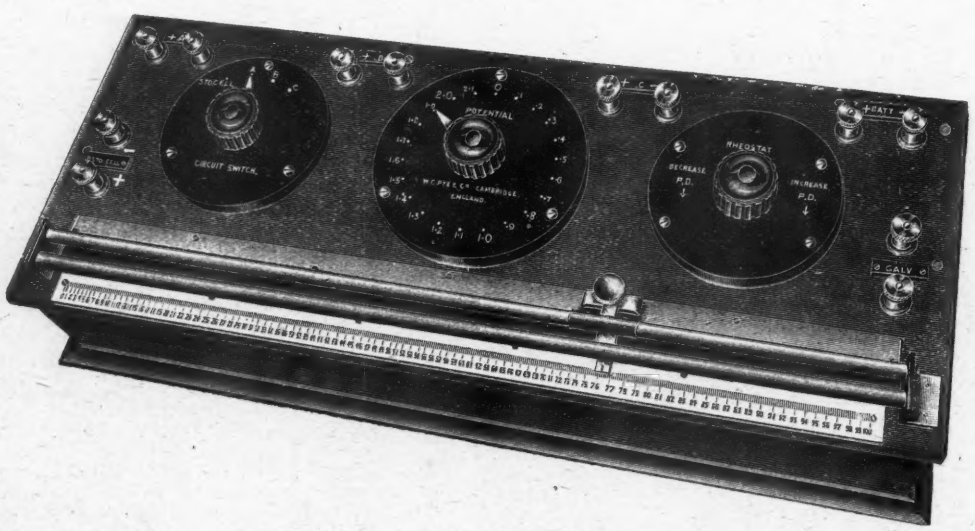


Fig. 5.—Twenty-two Section Potentiometer.

Messrs. Evershed & Vignoles, Ltd.

This firm exhibited the "Dionic" water tester in operation, showing its use for testing various samples of water. The apparatus was fully described in a recent issue.

(To be continued.)

Felixstowe Lighting.—A L.G.B. inquiry was held on December 20th into the application of the U.D.C. for a loan of £3,000 for electric light purposes. There was no opposition.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

A Miniature Ironclad Switch.

A neat little 12-amp. Y type ironclad switch, shown in fig. 1, has recently been placed on the market by Messrs. S. Bill & Co., of 54, Guest Street, Birmingham.

Despite its small size, it is solidly constructed, all the current-carrying parts being partitioned off and surrounded by fillets projecting from an English china base—which in itself is a novelty.

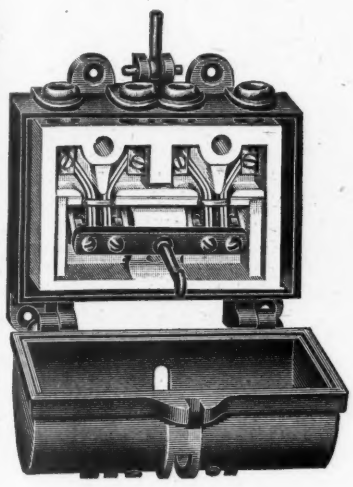


Fig. 1.—Small Ironclad D.P. Switch.

The hinged lid is secured by a wing-nut and screw, and lugs are provided for attaching the base, which measures 4½ in. × 4 in. over all, to the wall. We understand that some 3,000 of these switches have already been supplied.

Metal-Filament Lamp Fittings.

We have received from Messrs. J. & H. Grevener, of Eldon Street House, E.C., particulars of the numerous patterns of fittings for metal-filament lamps produced at their works.

A number of these mentioned in list M 12 are designed on arc-lamp principles, with high-grade enamelled cases, roller porcelain suspension insulators, clear flint-glass globes, &c., and provided with polished brass globe fittings, giving a very smart appearance.

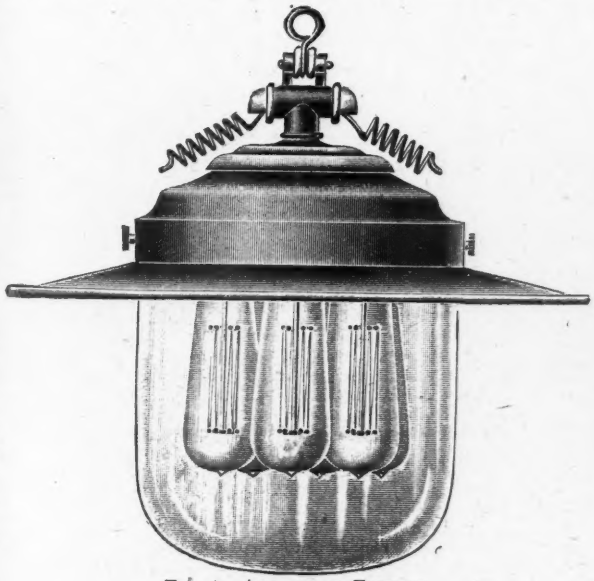


Fig. 4.—Aluminium Fitting.

These are suitable for lamps up to 1,000 c.p. in size, and can be supplied in brass and black or white lacquer finish. We illustrate in fig. 2 a 600-c.p. fitting with single lamp, but the fitting is adaptable for any number of pear-shaped lamps up to five; and fig. 3 shows a similar fitting designed for dock and railway lighting.

Some low-priced and effective fittings in aluminium, which are strongly made, and recommended specially for use in exposed positions and corrosive atmospheres, are described and illustrated in list A 14. These fittings are also suitable for single lamps of from 50 c.p. to 1,000 c.p., or for clusters, such as we illustrate in fig. 3, which shows a fitting with six 50-c.p. pear-shaped lamps, the globe diameter being 9 in.

A further list, F 3, contains a large variety of watertight cast-iron fittings for single and multiple lamps, pendants and bracket type fittings, lamp guards, reflectors, &c., designed particularly for rough usage and exposed positions, such as in ships, collieries, &c.

Messrs. Grevener draw special attention to this branch of their business, which is being extensively developed at the present time.

Fig. 2.

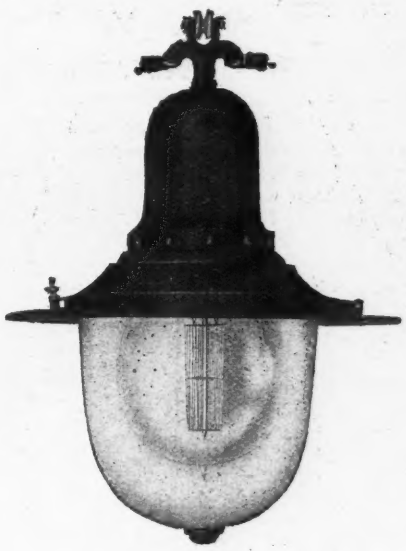


Fig. 3.

Grevener Metal-filament Lamp Fittings.

The Cherry-Bush Rotary Engine.

The Auto-Controller and Switch Co., of Simplex Works, Vienna Road, Bermondsey, S.E., have brought out a new rotary steam-engine under the above title, for which high qualities are claimed. The accompanying illustration shows the interior of the engine, the end cover being removed; the main parts consist of a cylinder with an internal projection, a rotor with radial vanes, and

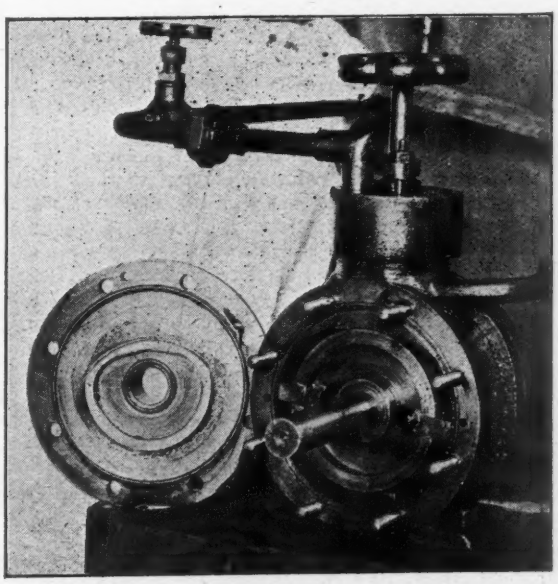


Fig. 5.—Cherry-Bush Rotary Engine.

end plates with ring cams which engage slots in the ends of the vanes. The projection in the upper part of the cylinder forms a steam seal; the vanes divide the chamber into two portions, and are drawn in or out by the ring cams so as to maintain contact with or close apposition to the cylinder walls at all parts of the revolution. Steam is admitted through one or other of two ports, on either side of the seal, by way of a valve on the top of the cylinder, which enables the engine to be started, stopped and reversed; the exhaust port apparently is the other of these

two ports. The engine is thus very simple; it is also claimed that it is remarkably economical. The inventors state that an engine with a cylinder 4½ in. in diameter and $2\frac{9}{16}$ in. wide, weighing 22 lb., gave 2·01 B.H.P. with a boiler pressure of 87 lb. per sq. inch, running at 665 R.P.M., while using less than half as much steam as a reciprocating engine of equal size. Using six such cylinders in series, with a condenser, they state that only 5 lb. steam per B.H.P.-hour was consumed—a result about twice as good as has ever been obtained with the largest steam turbines! Of course, so astounding a claim needs independent verification. The makers say that the success of the engine depends upon an essential feature which is not to be disclosed at present.

CONTRACTS RELATING TO THE SUPPLY OF ELECTRICITY AND MACHINERY.

[BY A LEGAL CONTRIBUTOR.]

QUESTIONS sometimes arise with regard to contracts for electricity and machinery. Many cases of this nature are discussed in the Courts, and reported in our pages, but as they are of technical rather than legal interest they do not often find their way into the law reports. It may be useful to consider the effect of some of the more important of these cases.

Suppose there is a contract to supply power, what are the obligations of the party supplying it? In one English case (Bentley *v.* Metcalfe, 1906, 2 K.B. 548) the plaintiffs agreed to become tenants of a room in a factory in which there was an engine, which was used to actuate the machinery in the building, including a machine in the room let to the plaintiffs, and the defendants agreed to supply power for the working of that machine. The question was whether the defendants were liable for an accident to one of the plaintiffs' workmen. The accident arose from the power which worked the plaintiffs' machinery, doing so in such a violent manner and at such a velocity that the drum of the machine was burst, and a workman was killed by being struck by one of the pieces. As employers, the plaintiffs were liable to pay compensation to the widow of the workman, and they brought an action to recover as damages the sum which they had to pay.

It was decided that the obligation of the defendants to supply did not arise upon a demise, but upon a specific contract which involved, in the absence of special conditions, that the power supplied should be reasonably fit for the purpose for which it was supplied, and that the defendants were liable for the consequences of a breach of the contract. The following passage from the judgment serves to explain the reason of the decision:—"There was, in fact, a purchase of something, whatever it may be called, and it seems to me that the principle which governs the relation of the parties upon a purchase and sale—namely, that the article bought should be fit and proper for the purpose for which it is to be used—is equally applicable to the supply of power." Where, as frequently happens in the case of a tenement factory, the owners of the factory supply power from a central plant to a large number of independent manufacturers, they would do well to consider the advisability of so limiting their liability that they cannot be sued for the damages caused by the main engine racing or other accident. The illustration above given relates to the supply of power by shafting. Where electricity is supplied from a central source on one factory, it may be well for the party supplying it to make special provision for a breakdown or sudden overload. There is no case which shows what are the limits within which the pressure of supply may vary without there being a breach of contract.

The use of technical terms in contracts for electrical work is very common, but is not unlikely to lead to confusion. In an unreported case a question arose as to what is meant by a "complete installation" in relation to the supply of electricity. The plaintiffs quoted for the electrical part of an installation which was to be used for lighting a house. The dynamo, which was to charge accumulators, was to be worked by a 3-H.P. engine, which the defendant had in his possession. The plaintiffs agreed to provide a complete installation for a certain sum, that sum being made up of a number of items, including accumulators, switchboard and other fittings, but apparently not including a cut-out or shunt resistance. The main point in the case was whether a cut-out and a shunt resistance were necessary parts of a complete installation. If so, they could not be charged for as extras. It was contended on the part of the defendant that, even given a good 3-H.P. engine, a cut-out and resistance were necessary. The plaintiffs, however, replied that when making their estimate they assumed that the engine was new; that if it had been new, a cut-out would not have been necessary, and that they were, therefore, justified in charging for cut-out and resistance as extras. They also alleged that since the specification was made out, the defendant had demanded an increase in the size of the battery. Had they known that the battery was to be larger, this would have influenced their judgment in deciding whether to provide a cut-out. In an action for the price of the work done, the judge decided this point in favour of the defendant, laying it down that for a complete installation a cut-out and shunt resistance should be supplied. He was not, apparently, impressed with the argument that the increase in the size of the battery would have affected the plaintiffs' judgment.

In cases where the works, on completion, are a source of danger to third persons, the employer may sometimes seek to recover damages from the contractor for injuries so sustained. To determine the question whether the contractor is so liable, it is necessary to consider the terms of the contract with some care. To take a clear case: if the contract provided that dangerous machinery was to be guarded, the contractor would be held liable for any accident arising owing to his omission to provide a guard. Questions of this kind sometimes arise in relation to wiring contracts. In one case a contract for the installation of electric light in a building to be used for the purposes of public baths and wash-houses provided (*inter alia*): "That the whole of the work is to be carried on in accordance with the existing rules as framed by the Phœnix Fire Office." Rule 5 of these rules provided that: "Where a system of metal tubes is employed the metal tubes should be earthed, except in those cases where earthing would not be desirable." A system of metal tubes was employed for the work, and in consequence of such tubes not being earthed, a bather received an electric shock, which caused his death. The local authority, which owned the baths, paid damages in respect of his death. In arbitration proceedings, in which the local authority sought to recover the sum so paid from the contractors, the arbitrator found that earthing the tubes would not have been desirable so far as risk of fire was concerned, but would, in fact, have been desirable so far as risk of accident to bathers was concerned. It was held, upon the hearing of a special case stated by the arbitrator, that inasmuch as the insurance company's rules were framed for the prevention of fire, and earthing was not desirable for that purpose, there had been no breach of contract, and that therefore the wiring contractors were not liable.

THE LIGHTING OF WESTMINSTER.

THE Works Committee of the Westminster City Council report having further considered the offer of the St. James' and Pall Mall Electric Light Co., Ltd. (to which we have already referred in our "Lighting Notes"), to provide and maintain for five years at their own expense additional public lighting at Piccadilly Circus by means of electric flame arc lamps on 35-ft. columns. The Committee received a letter from the Gas Light and Coke Co., dated November 22nd, stating that they had been informed of the permission given by the Council to the St. James' and Pall Mall Electric Light Co. to erect the proposed arc lamps, the reason given being that the installation would secure a continuance of the "experiments" in street lighting by electric arc lamps. They urged that this is not a fair form of experimental lighting, but is in reality giving the Electric Light Co. an opportunity of advertising at the expense, in everything but money, of the Council and the Gas Co.; and they pointed out that there can be no experiment which does not include the cost of lighting, neither can any experiment be useful which compares a cluster of four high power electric arcs with one high power gas lamp. The Gas Co.'s letter went on to say that the contract for lighting certain clearly-defined thoroughfares by means of gas was allotted to the Gas Co. in open competition with other forms of illumination, and they feel strongly that, in the absence of default on their part, they should be given the entire lighting of the contract area, and they say this view is supported by the wording of Clause 4 of the contract, dated May 23rd last, which states that, with the exception of certain thoroughfares of which Picca-

dilly Circus is not one, "the contract is intended to include the installation and maintenance of lights in place of all the lights specified in the schedule." Moreover, this point is covered by Clause 10 of the general conditions of contract, which clearly indicated that any additional lighting, if found necessary, is to be provided by the contractors, as the Council retain the power "to increase the number of lamps, as and when they may deem desirable, such additional lamps being provided and maintained at the prices in the accepted tender." The company, in conclusion, expressed a respectful, but earnest, protest against the introduction of a second system of lighting at Piccadilly Circus without reference to the existing contractors, especially seeing that the contract with them has been so recently entered into. They further expressed the hope that it may not be too late for the Council to reconsider the matter. The Committee had also received a letter from the St. James' and Pall Mall Electric Light Co., dated December 13th, enclosing a memorandum upon the subject, in which they claim that there is no legal ground to support the contention of the Gas Co., that under their new contract they have a monopoly of any form of street lighting in the district in question, and that in the event of the Council deciding to rescind their acceptance of the offer of the additional lighting, the only alternative for the Electric Light Co. is to dismantle its derelict apparatus and to retire altogether from a competition in which, they say, they cannot expect to receive fair consideration. Since the Electric Light Co.'s offer was made (the Committee report) the new gas lighting has been installed at Piccadilly Circus; it consists of four lamps of 3,000 C.P. each and three of 1,800 C.P. each, being an aggregate of 17,400 C.P. Some of the members have had an opportunity of seeing the new lighting, and they are satisfied that it is ample, and a great improvement on the old lighting. The St. James' and Pall Mall Electric Light Co.'s proposal is to put up on columns 35 ft. high, *i.e.*, 15 ft. taller than the gas lamps, electric lamps to give an aggregate lighting power of 36,000 candles, in three clusters, each giving 12,000 C.P. Such an enormous concentration of light (whether electric or gas) would, the Committee consider, depreciate the effect of the new lighting which the Council have so recently required under the contract, and would, from the point of view of public lighting, be superfluous. Under all the circumstances they recommended that the resolution of the Council of November 10th, 1910, accepting the offer of the St. James' and Pall Mall Electric Lighting Co., to provide and maintain for five years, at their own expense, certain additional public lighting at Piccadilly Circus, be revoked, and that the offer be not accepted.

At the meeting of the Council on December 22nd the report and recommendation were brought up, and their adoption was formally moved.

Councillor Flint, in objecting to the motion, called the Council's attention to the unanimity with which the Works Committee had at first decided to allow the Pall Mall Co. to proceed with their proposed experiment. He trusted that the Council would realise that the company's offer was a *bona fide* one, as shown by their willingness to change to any other system the Committee might think better in future. He was astonished to learn that, as a result of the last Committee meeting, at which he was not present, the decision arrived at after full discussion at the first meeting had been reversed. He would like to hear from some member of the Committee what had taken place to cause them to change their minds. The only reason he could see was that the Committee thought the experiment asked for would be depreciating the effect of the new gas lighting which they had acquired under their contract. That would be a very weak argument in favour of rescinding the previous motion. There seemed to be some sort of idea that the Council, having made a contract with the Gas Light and Coke Co., had thereby granted that company a monopoly. He contended that there could be no such thing as a monopoly of this sort, and the Council were perfectly free to sandwich electric light between gas lights in Piccadilly if they wished to. It was not in the Council's power to grant a monopoly, and another point was that they had the right to order a supply of electric light within 75 yd. of any distributing main. The Gas Co. had sent a sort of sentimental appeal to the Committee which he thought was mostly bluff. In his opinion, at the present time Piccadilly Circus was badly lighted for a great place like that. He was in a better position than most members of the Works Committee to know, because he had to walk up Regent Street home more often than other people. The lighting was not so good as it used to be, and he could quote other tradesmen in Regent Street who would express the same opinion. The light did not come near the top of the houses, it only came halfway up, whereas the electric light used to go right to the top. If they had this experimental lighting with the other, Piccadilly would be the best lit spot in the world. It was a very good ground for demonstrating improvements that were taking place in both gas and electric lighting, and they wanted a demonstration ground for that purpose in London. Further, he did not approve of the present contract with the Gas Co.; it was of an unsatisfactory nature. The company on their own admission had entered into the contract, solely with the idea of exploiting the Council as an advertisement medium. It was necessary for the Council to have a lively competitor with the Gas Co., or they would place themselves at the company's mercy, and they did not know what terms the latter would extract at the end of the contract. If they allowed the electric light company to put up these standards in Piccadilly, they would have a hold on the gas company, while the extra light would be a boon to the public at large.

In the absence of the chairman of the Committee, Councillor Smith explained that the Committee had reversed their decision, because they felt they would be placing the Council in a false position if they allowed the electrical experiment. The gas company had contracted to do the lighting at from 30 to 80 per cent. cheaper than the other company, and it would not be fair to allow opposition lighting in the same district.

The report and recommendation were then adopted without further comment.

BUSINESS NOTES.

German Branches in Belgium.—The financial results of two German subsidiary companies in Belgium, for the year 1909-10, have just been announced. The first is the Compagnie Belge d'Electricité Siemens-Schuckert, of Brussels, which has a share capital of £40,000 paid to the extent of 50 per cent., and of which the Berlin parent undertaking holds £21,400. The company earned a surplus of £12,900, as against £13,600 in 1908-9, and after deducting general expenses the balance allows of the payment of a dividend of 7 per cent., being the same rate as in the previous year. In the case of the second company—Siemens & Halske, Société Anonyme Belge—the share capital also amounts to £40,000, of which only £3,600 remains unpaid, and £35,000 out of the total is vested in the Siemens & Halske Co., of Berlin. The accounts of the Belgian company show gross profits of £5,500, and after meeting management expenses and depreciation, the balance permits of the distribution of 4 per cent. for 1909-10.

Consular Notes.—Italy.—The British Consul at Milan, in a recent report on the trade of Lombardy, states that Ing. Guido Semenza, the well-known electrical engineer at Milan, has supplied him with valuable information as to the development of the electrical industry in Lombardy. It appears that according to official statistics published in 1900 there were in Italy at the end of 1898, 2,264 generating stations developing 86,176 KW., of which 47,500 KW. were developed by water power, and some 36,000 KW. by heat engine power. In the absence of later official statistics, data respecting some 200 important new stations which have arisen since 1898 have been collected, and their total output amounts to 415,000 KW., or adding the 86,000 KW. previously existing, the total output is 501,000 KW. The total output of the smaller stations may be reckoned at 60,000 KW., and consequently there are some 560,000 KW. developed in Italy, and when it is remembered that machinery to develop about 475,000 KW. (whereof 400,000 KW. are from water-power and 75,000 KW. from heat engines) has been installed during the last 10 years, equal to 680,000 H.P., an idea may be formed of the importance attained by this industrial movement. However, it must not be thought that the power actually used or developed amounts to the figure given above, as part of the electrical machinery is kept in reserve, and some of the steam plant is intended to replace the hydraulic plant when the rivers are low. Taking these circumstances into consideration, it may be reckoned that the power being utilised is between 440,000 and 480,000 KW. Reckoning the water power stations—including their hydraulic works, machinery, lines and transformers—to cost altogether 1,000 lire per KW. on an average, and those generating by steam to cost 350 lire per KW., it appears that 500,000,000 lire have of late years been devoted to the development of electric power in Italy. Before 1898 nearly all the installations were either on the continuous-current or alternating monophase system (except the one at Paderno, which is three-phase, and the two-phase one at Pavia, and a few others); but since that date the vast majority have adopted the three-phase system. The earlier installations in Italy with alternating current had a frequency of 42 periods, but the German frequency of 50 periods has also been introduced, so that with a few exceptions two frequencies are used in Italy—42 and 50 periods, both excellent in practice, but apt to cause complications when worked together. In 1898 the highest pressure in Italy was barely 14,000 volts, and it was then thought to be very bold to attain that figure, especially as it was directly generated from the alternators. The first advance was the Brembo installation, where 25,000 volts were adopted, then came the Cellini line, 70 km. long, with a pressure of 30,000 volts, the Brusio line of 40,000 volts and 145 km. long, and the Toce 50,000-volt line, 160 km. long. Now the Adamello line is about to be used, having a pressure of 65,000 volts normal which may under certain conditions reach 72,000 volts. Italian engineers have always been bold in the matter of lines of transmission. They were the first to use metal standards or posts with long intervals between them. From 60 metres the maximum normal span in 1899, passed to 80 metres, then gradually to 120 metres, and the Adamello will have 180 metre spans. This increase is with an economical object. It is interesting to note that in the mountainous region of the Brembo, a line which has stretches of up 280 metres has given every satisfaction during the five years it has been in use. It should be observed that the progress made in the manufacture of cables allows of their use to complete overhead lines on their approach to big towns. Power stations generally resemble each other, but those in Italy have a number of differences which make them very interesting. The first electric tramway in Italy was the Florence-Fiesole line, which was opened in 1890, and was followed by others in Genoa, Milan, Varese and Rome. By the end of 1898 there were no more than 200 km. of electric tramway lines. The official statistics of 1903 give the length of lines, then at 506·428 km. and the number of cars at 1,411. What the total figure is at

present cannot easily be ascertained, but considering the development that has taken place in all large towns and the many inter-urban lines, it is estimated there are more than 1,500 km. of single lines in Italy. Nearly all the large and the medium-sized towns have tramway lines now, but there is still an opening for inter-urban lines. Although Italy does not occupy a prominent place as regards extensive use of electric traction on its main railway lines, it has, nevertheless, been the field for interesting experiments. The third-rail system on the Milan-Varese-Porto Ceresio line, on the one hand, and the three-phase current applied for the first time on the Vatellina Railway on the other, have afforded much instruction. The electro-chemical industry, which has given the best results hitherto, is the manufacture of calcium carbide; the factories at Terni, Darfo, Pont S. Martin, Pont S. Marcel have supplied the market with large quantities; unfortunately, the world's supply has exceeded the demand, and prices have fallen. The other products are less important. Caustic soda is produced at Bussi and Brescia by electro-chemical processes with satisfactory results. At Bussi aluminium is likewise extracted. In the preparation of artificial manures, calcium cyanamide, &c., electricity is also used. Dynamos, transformers, motors, wires, lines, instruments, switches and accessories, as well as incandescent and arc lamps, are made in Italy. There is, nevertheless, a considerable import trade. Although the capacity of electrical installations has increased during the last 10 years by about 500,000 KW. of installed machinery (of which about one-seventh are developed by heat-engine power and the rest by water power) the consumption of coal has doubled. In 1898 it was 4,426,524 tons, and in 1908 it had risen to 8,452,320 tons.

It appears from the Italian trade returns that during the year 1909 there were imported 43,000 quintals (100 kg.) of machines exceeding 1 ton in weight, while during the year 1908, 53,000 quintals were imported. The decrease was in German machines, which dropped from 36,000 to 26,000 quintals. Switzerland, on the other hand, gained 2,000 quintals, the imports from that country amounting to nearly 8,000 quintals. Italy bought 24,000 quintals of light machinery, instead of nearly 30,000 quintals during the previous year. Here again Germany lost about 6,000 quintals, descending to 17,000 quintals, while Switzerland gained 1,000 quintals, ascending to nearly 2,000 quintals. The imports into Italy have, therefore, decreased by about 15,000 quintals as compared with the previous year, and amounted to 67,000 quintals. Germany has been the loser by this decrease by about 16,000 quintals, while Switzerland gained 3,000 quintals. The quantity of new electrical machinery entering Italy each year is probably stationary. The purchasing market has remained the same, but Germany has lost to the advantage of Italian manufacturers and those of other countries. The rapid extension of electric lighting is shown by a notable increase in transformers, and by the returns of imports of electric lamps, for while arc lamps remained about the same, incandescent lamps rose from 5,000,000 to 6,500,000, and the installed power for electric light must have risen from 300,000 KW. to 400,000 KW. Industry in Italy is not receding. It is sufficient in order to be convinced of this to note that more than 9,000,000 tons of coal were imported, with an increase of 800,000 tons over 1908. With this weight of fuel 6,000,000,000 H.P.-hours have certainly been produced without reckoning those generated by water-power and estimated at about 2,000,000,000 H.P.

Argentine.—The Austrian Consul-General at Buenos Ayres reports that the trade in electrical materials is almost entirely in the hands of German exporters; the total import of electrical material in 1909 was valued at 4,217,000 pesos.

Brazil.—The Austrian Consul at Sao Paulo, in a recent report, states that great steps have been taken in the State of Sao Paulo in the utilisation of natural water powers for the production of electric energy. Up to the present the following plants for the utilisation of water power have been established:—The plants of the Sao Paulo Light and Power Co., at Parnahyba, with about 8,000 H.P.; in Jundiahy, with 1,000 H.P.; in Rio Claro, 580 H.P.; in Sorocaba, 1,000 H.P.; in Mococa, 500 H.P.; in Piracicaba and Itatinga, 3,000 H.P.; further plant will supply the power necessary for the docks at Santos, and for lighting and power. The following water powers whose capacities have been estimated by experts have not yet been utilised:—The Parana Fall of Urubutunga, with 450,000 H.P. in the extreme west of the State of Sao Paulo; the Fall of Patos, with 400,000 H.P.; Marunbonbo, with 61,000; Avanhandava, with 57,700 H.P.; and those of Itapura, Juqueryquere, Cruzes, and Ilha Secca, with 40,000 H.P. each.

The demand in the State of Sao Paulo for machinery, machine tools, &c., is relatively very great as the small industries are beginning to extend their use of machinery; the figures of importation were slightly less than in the previous year, however, owing to a falling off in the demand for machine tools. In 1909 the imports were valued at 11,601,738 milreis, as against 12,167,850 milreis in the previous year. The imports of machines and apparatus for electric lighting and power amounted in value to 1,586,213 milreis, as against 1,233,393 milreis in the present year; the chief supplying countries were the United States, 912,735 milreis (previous year 873,788 milreis); Germany, 462,529 milreis (previous year 250,809 milreis); and the United Kingdom, 146,248 milreis (previous year 72,110 milreis). The increase in the imports is due to the rapid extension of the utilisation of electricity for lighting towns and for industrial enterprises, and, taking into account the possibilities for the use of water-power in the near future, the demand for electrical machines and apparatus is likely to increase to a very great extent. The imports of electric cables amounted in value to 55,491 milreis, as against 180,128 milreis in the previous year, chiefly from the United States 22,910 milreis (previous year 119,740 milreis), and England 26,504 milreis (56,754 milreis in the previous year); the chief customer is the Sao Paulo Tramway, Light and Power Co., Ltd., which draws its supplies chiefly from New York. The imports of boilers were valued at 114,614 milreis, chiefly from England (79,360 milreis), Germany (22,448 milreis), and France (11,069 milreis); the total imports in 1908 were valued at 96,584 milreis. The imports of hydraulic pumps were valued at 78,801 milreis, chiefly from U.S.A. (37,237 milreis), England (19,527 milreis), Germany (15,773 milreis). The imports of gas, petrol, &c., motors were valued at 466,277 milreis, as against 747,039 milreis in 1908, chiefly from England (214,067 milreis), and the United States (150,506 milreis). Machines for industrial purposes were imported to a value of 2,770,038 milreis as against 2,981,281 in 1908; the imports were chiefly from England (1,723,010 milreis), Germany (652,097 milreis), France (248,854 milreis), Austria (53,032 milreis), Italy (28,670 milreis), and the U.S.A. (25,413 milreis); the imports from the U.K. increased from 212,650 milreis in the previous year, whilst those from U.S.A. decreased from 252,417 milreis. The imports of glass and porcelain insulators were valued at 84,338 milreis, as against 47,910 milreis in the previous year, and came chiefly from Germany (27,330 milreis), France (26,697 milreis), and U.S.A. (18,219 milreis). The telephone system was widely extended in 1909, and the interurban system was inaugurated so that the chief towns in the interior of the State are now united by telephone to the capital.

Tungsten Lamps.—The British Tungsten Lamp Co., Ltd., of Huyton Quarry, near Liverpool, have again secured a contract from the London County Council for the supply of the carbon-filament traction lamps for the tramcars for next year. They have also again received acceptance of their tender for part of the requirements of the Cunard Steamship Co. for carbon and metal-filament lamps for next year. The company make a speciality of traction lamps, and lamps for ship lighting.

Staff Dinner.—The Felgate Electrical Installation Co., of Reading, who have recently opened a branch in Ascot, gave a staff dinner—to which many of the company's customers were invited—at the Royal Hotel, Ascot, on Wednesday last week. Mr. B. P. Gibbons, managing director, who presided, was supported by Mr. F. Cook, another director, as vice-chairman, and by some of the more prominent residents in the locality. About 50 guests attended.

Book Notices.—*The Commercial Year-Book of the Leicester Chamber of Commerce.* London: Bemrose & Sons, Ltd.—This book is issued by the Leicester Chamber of Commerce in the interests of its members and the trade of the town and district. It is circulated largely in the home and foreign markets, and tells all that most people will require to know regarding Leicester, its commercial and industrial features, its sites suitable for factories, its electricity and gas supply, &c. It has an index (in English, French and Spanish) to its various trades and traders, and should serve a useful purpose in connection with the industrial development and prosperity of Leicester.

"The Official Circular of the Tramways and Light Railways Association" for December contains a list of applications for Tramway Orders submitted to the Board of Trade during 1910; a list of applications made to the Light Railway Commissioners in November, 1910; copies of the awards in the Paisley Tramways and the Dudley Tramways arbitrations; and other matters relating to the Association. An index is included for "The Official Circulars" from the year 1903 to the year 1910 inclusive.

"*Journal* of the Franklin Institute." Vol. CLXX, No. 6. December, 1910. Philadelphia: the Offices of the Institute. Price 50 cents.

"Fowler's Mechanics' and Machinists' Pocket-Book and Diary." 1911. Manchester: Scientific Publishing Co. Price 6d. net.

"Hazell's Annual, 1911." London: Hazell, Watson & Viney, Ltd. Price 3s. 6d. net.

"The Electrical Engineers' Diary, 1911." London: S. Davis and Co. Price 2s. 6d.

Calendars and Catalogues.—The Electric Supply Publicity Committee, Moorgate Court, E.C., has sent us one of its 1911 calendars, with small monthly slips. The pictorial feature of the card, which shows the startling effect produced by the electric light upon the gentleman with the old candlestick, should secure the interest of many an uneducated gas or oil user.

Messrs. The Benjamin Electric, Ltd., 1A, Rosebery Avenue, London, E.C.—Supplementary list (No. 3A), particularising and pricing the Benjamin reflector fittings.

The Electric Construction Co., Ltd., of London and Wolverhampton, have issued a neat card and stamp case for the vest pocket, with a small diary; each opening represents one month's days, so the daily space is just enough to enter in contracted form one's principal engagements. Two memoranda pages appear at the beginning—doubtless for recording new year resolutions—and two pages at the end are, we suppose, meant to tell which had been kept, and why.

Messrs. Alfred Herbert, Ltd., of Coventry, have issued one of their now familiar calendars, in the same style as in previous years, with bold block figuring and half-tone pictures of their machine tools.

The General Electric Co., Ltd., Queen Victoria Street, London, E.C., are issuing again to users of their "desk reminder" a set of daily slips for 1911, to fit on to the stand in place of the filled-up ones of 1910.

The Brush Electrical Engineering Co., Ltd., 1, Kingsway, London, W.C., have again favoured us with their very acceptable little vest-pocket diary and notebook (Letts's) for the new year, with insurance coupon.

The County Fire Office, Ltd., 4, Lombard Street, London, E.C., has in circulation a neat desk standing calendar with monthly cards.

Messrs. Venner & Co., of 6, Old Queen Street, Westminster, S.W., are circulating to those who are still using the neat wall calendar frame that they issued a year or two ago a set of monthly date cards for 1911 to fit therein. They are also favouring such of their friends as they understand to have a need for it, with a seasonable souvenir in the shape of a leather sovereign purse. If any customer of the firm has been overlooked in sending these out, Messrs. Venner will endeavour to forward one on receiving intimation, but the stock is practically exhausted.

The Electrical Co., Ltd., 122-4, Charing Cross Road, London, W.C.—Binding cover containing a number of well arranged illustrated lists of electromagnetic, moving coil, induction and hot-wire switchboard instruments, induction switchboard wattmeters, moving-coil portable instruments, and other electric measuring instruments.

The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—Four bulletins have been issued as supplements to the company's catalogues. The catalogues are arranged mainly from a technical point of view, but these bulletins contain particulars of apparatus connected with a certain trade or a certain style of application, accompanied with explanatory matter. The first, "Important Plant," is practically a revision of the preceding issue, and shows illustrations of the firm's latest developments in large engineering work, there being included continuous-current machines up to 1,500 kw., alternating-current generators up to 1,500 kw., rotary converters up to 600 kw., turbine plant, both continuous and three-phase, the former up to 750 kw., and the latter up to 3,200 k.v.a. A list is given of large installations carried out by the company. Bulletin No. 2—"Shipyard and Engineering Works"—is devoted principally to the application of motors for use with machinery, particularly in application to shipyards, dockyards and engineering works. Approximate prices appear for the various machinery. Bulletin No. 3—"Sumpner Instruments"—is entirely devoted to these patent instruments, and the explanations of their construction and uses, with details of tests to which they have been submitted, &c. Bulletin No. 4 deals entirely with isolated sets for country house lighting. The Osram-Punkah set is included among its interesting features, the lamps being lit and the punkah driven from the one small plant. We congratulate the G.E.C. upon the very fine style in which these four brochures have been produced.

The Hart Accumulator Co., Ltd., Stratford, London, E.—Once again this firm is obliging its friends with a desk blotting-pad with handy top pocket. It has also issued a new illustrated price list of its "Hart" motor-car lighting batteries.

Messrs. Alfred Graham & Co., St. Andrew's Works, Crofton Park Road, London, S.E., have sent us a neat and useful blotting pad with 1911 diary at left-hand side. The user is unlikely to forget their patent loud-speaking naval telephones.

Messrs. Haslam & Schontheil, Ltd., of Western Mail Chambers, Cardiff, have sent us a sketch or scribbling block (squared paper) which will fill a very useful purpose for some weeks or months to come. Here and there one finds, quite unobtrusively, illustrations by way of a reminder concerning the kinds of material handled by the firm.

Mr. John Whitelaw, 15a, Duncan Street, Edinburgh, sends a wall calendar with monthly slips for 1911. The picture "The Hustlers" (newspaper boys all anxious to secure your esteemed order) is capital.

Messrs. W. Geipel & Co., 72a, St. Thomas Street, London, S.E.—From this firm we have received a neat vest pocket diary, with insurance coupon, and a number of engineering tables arranged by Mr. Geipel.

Fire.—There was a small outbreak of fire on December 22nd in the winding room at the works of Messrs. Dick, Kerr and Co., of Strand Road, Preston. The outbreak was extinguished by the firm's own brigade.

Stolen Scrap.—At Sutton (Surrey) Police Court on the 21st inst., Joseph Maynard, a carman, was charged with stealing a quantity of cable and other material belonging to the South Metropolitan Electric Lighting and Tramway Co., Ltd. The general manager, Mr. G. V. Mason, said the property was scrap, of which they had missed a good deal lately. When arrested the prisoner said it was given to him at the electric light works, but he afterwards pleaded guilty to stealing it.—Mr. Mason said that although the company did not wish to press this particular charge, they had been losing large quantities of scrap at their three depôts, and were anxious to find the receiver.—Maynard was bound over under the First Offenders' Act.

Trade Announcements.—With reference to the notice in our last issue regarding Messrs. Felten & Guilleaume L.A.G.'s agency, Messrs. W. F. Dennis & Co., of 49, Queen Victoria Street, E.C., state that this alteration makes no difference whatever in the agency which they have held for Messrs. Felten & Guilleaume for the last 33 years, and which they continue to hold.

The Mirrlees Watson Co., Ltd., announce that their offices have been removed to 122, Cannon Street, E.C.

The General Seating Co., Ltd., have removed their office from Northampton Park, Canonbury, N., to 13, City Road, London, E.C.

Messrs. Mirrlees, Bickerton & Day, Ltd., have removed their London offices to 122, Cannon Street, E.C.

Messrs. Todhunter & Elliot, Ltd., of Duke Street, Douglas (Isle of Man), have opened an electrical engineering department, which is under the charge of Mr. Perry, formerly chief electrical engineer with Messrs. Waring & Gillow, Ltd.

Mr. Robert Jenkins announces that on and after January 1st his address will be "57, Bishopsgate," E.C., his present building (88, Bishopsgate Street Within, E.C.) having been renumbered.

Dissolutions and Liquidations.—North British Electric Power Syndicate, Ltd.—This syndicate is winding up voluntarily, with Mr. A. Wood (Monkhouse, Stoneham & Co., Salisbury House, E.C.) as liquidator. A meeting of creditors is called for January 2nd.

The Telegraphic Code Co., Ltd.—A meeting of creditors will be held at 318, Moorgate Station Chambers, Moorfields, E.C., on January 3rd.

Davey Electric Co., Ltd.—A meeting is to be held at the office of the liquidator (Mr. J. Andrews, 20, North John Street, Liverpool) on January 31st, to hear an account of the winding up.

Messrs. A. Watson & Co., electrical engineers and electrical motor accessory manufacturers, Edward Street Works, The Parade, Birmingham.—Messrs. W. J. Charles and A. Watson have dissolved partnership.

The Holidays.—The District Electric Co., Ltd., of Wolverhampton and Birmingham, inform us that their offices were closed on December 24th, and will re-open on January 2nd, 1911.

Bankruptcy Proceedings.—Edwin Moorhouse, electrical engineer's traveller, Leeds.—Receiving order made December 22nd, at Leeds, on debtor's own petition. First meeting January 9th; public examination, January 17th.

LIGHTING and POWER NOTES.

Atherton.—A local correspondent states that the opinion is generally held that the appalling disaster at the Hulton Colliery Co.'s No. 3 (Victoria) Pit, at Atherton, in which over 300 lives were lost, was caused by an explosion of coal dust, there being no suggestion of the fusing of an electric cable. The Hulton Colliery Co.'s pits at Chequerbent and Atherton are amongst the finest electrically-equipped collieries in the kingdom, an extensive generating plant having been put down there three or four years ago; in fact, the pits are regarded as model coal mines, and were visited by Continental mining experts a short time ago.

Australia.—A report by the Electrical Supply Committee of the Melbourne City Council, which was adopted by the Council on October 24th, recommended the extension of the city electrical plant by the erection of a battery. It was estimated that the total cost of the extension would be £29,540, including £21,000 for a 4,000-ampere-hour accumulator battery, with switches, connections, booster, &c., and £540 for pilot cables, &c.

Barrhead.—The cables of the Clyde Valley Electrical Power Co. have now been extended to Barrhead. Already a lighting installation has been made in one of the churches, and various business and domestic premises in the main street are being wired. The company have erected two lamps in Main Street as a test for street lighting.

Bingley.—The B. of T. has informed the U.D.C. that it has refused the application of the Council for the cancellation of the powers in the district possessed by the Yorkshire Electric Power Co.

Budleigh Salterton.—At a meeting on the 20th inst. of the U.D.C. a letter was read from Messrs. J. and W. Purves, of Exeter, with reference to the proposed electric lighting of the town, stating that it was their intention to install in their generating station at Budleigh Salterton either suction gas plant with gas engines or else Diesel oil engines as the motive power. The surveyor was instructed to have an interview with Mr. Purves as to the proposed site.

Burnham (Somerset).—Messrs. Jacques have informed the U.D.C. that they do not intend proceeding with the application to the B. of T. for a prov. order for E.L. The firm will, however, communicate further with the Council on the matter of E.L.

Burry Port.—The U.D.C. has decided to abandon the idea of applying for a prov. order for E.L.

East Ham.—A L.G.B. inquiry was held at East Ham on on December 21st into the application of the T.C. for a loan of £17,430 for electricity purposes. There was no opposition.

Falkirk.—At a meeting of the Corporation the clerk read a letter which he had sent to the Secretary for Scotland with reference to the taking over of the Falkirk Merchants' Electric Light Association's plant. In view of the terms of the Secretary for Scotland's reply it was agreed to allow the matter to lie over meantime.

Faversham.—The T.C. has decided to apply to the B. of T. for permission to erect an overhead cable to supply energy for lighting in Union Road. The cost will be only £50 against £132 for underground mains.

Finchley.—It was reported at the last meeting of the Council that the well at the electricity works was now 700 ft. deep, and the results of the preliminary pumping had been very satisfactory. The L.G.B. wrote with regard to the recent inquiry as to the Council's application to borrow £10,000 for electricity mains. The letter stated that during the inquiry it was suggested that the local authority should consider the advisability of increasing the amount applied for so as to cover the Council's requirements for a further period of at least 12 months, *i.e.*, to March, 1913. The Board, having carefully considered the electrical engineer's report upon the subject, recommended that the Council ask that the amount applied for be increased by £5,500, made up as follows:—Mains, £2,250; consumers' connections, £2,000; meters, £1,250. This was agreed to.

Greenock.—At a meeting of the Corporation it was reported in regard to the proposed supply of energy to Port Glasgow that the question of a combined guarantee had been under consideration, but the objections of the majority to this proposal had not been overcome. The engineer was instructed to ascertain the extent to which the power users were prepared to give individual guarantees. In connection with the extension of plant at a cost of £22,000, Mr. Robertson, engineer, reported that the necessity had arisen through applications from Scott's Shipbuilding Co. and the Admiralty for the torpedo factory. In carrying out the extension, it was pointed out, the Corporation would only be fulfilling its obligation as a supply authority. The extensions include buildings, cables, coal handling, &c., at Dellingburn works.

Harrogate.—The T.C. has applied to the L.G.B. for a loan of £2,000 for mains extensions, and £500 for services.

The B. of T. has sent the T.C. the draft order for extending the area of lighting outside the borough.

Hull.—The Electricity Committee of the T.C. on December 21st decided to recommend the T.C. to carry out extensions at the electricity works, at a cost of from £90,000 to £100,000, to apply for the necessary loan, and to obtain tenders so that the new plant may be running next autumn. It is proposed to build a new power house in Sculcoates Lane, to contain an additional 4,000 KW. of plant, and to be large enough eventually to house machinery of a total capacity of 16,000 KW.

India.—The *Times of India* for November 9th says that the Tata Hydro-Electric Power Supply Co. was registered about that date, with a nominal share capital of two crores—of which only one crore and 20 lakhs is to be issued at present—and in addition, a debenture capital of 85 lakhs, of which 55 lakhs have been issued. "The directors are Sir Dorabji Tata, chairman, the Hon. Sir Sassoon J. David, Mr. Shapurji B. Barucha, Mr. R. D. Tata, Mr. Prabshankar Pattani, the Hon. Mr. Lallubhai Samaldas, the Accountant-General of Baroda, and Mr. H. J. Bhabha, of Mysore. The construction engineer, Mr. Dickinson, is in Bombay, and specifications of the work to be done are already in the hands of the contractors. Mr. Joyner, the hydraulic engineer for the scheme, leaves London on Thursday for Bombay. Preliminary operations have already commenced; Government will promptly acquire the necessary land for the two reservoirs at Lanowli and Walhwan, and as much progress will be made as possible during the present dry season."

Kendal.—The T.C. has applied to the South Westmorland R.D.C. for consent to supply electricity to the parish of Underbarrow and Bradleyfield by means of overhead wires. The R.D.C. has referred the matter to a Committee with power to act.

London.—ST. PANCRAS.—The borough treasurer has reported upon the income-tax allowances on the electricity undertaking. For the purpose of charging income-tax, he writes, the Commissioners have from the year 1900 allowed the Council 2 per cent. depreciation in respect of the mains, machinery and plant of the electricity undertaking, which was confirmed on appeal in 1903, and has been acted upon and continued up to the year 1908-9, the result being that, upon an average, about £5,000 per annum has been deducted each year from the gross profits of the undertaking in order to arrive at the income-tax chargeable. When this rate of depreciation was granted, it was neither intended nor meant to cover everything as regards allowances, inasmuch as the Commissioners were also willing to allow sums each year from the income-tax assessment for all moneys spent upon repairs and renewals (other than in place of obsolete plant, &c.) paid out of revenue or reserve, and in the case of renewals there were included, if necessary, new mains and machinery substituted in place of old mains and machinery worn out. The 2 per cent. allowance was simply in respect of any possible explosion, breakdown or obsolescence of plant which was not really worn out, and, therefore, was in the nature of an extraordinary allowance. No other allowance for depreciation has ever been made, and it is satisfactory to know that by representations made by the Institute of Municipal Treasurers and Accountants to the Board of Inland Revenue, an increased percentage has now been obtained for all electric lighting undertakings, as will be seen by the following extracts from a circular of the board addressed to surveyors of taxes, viz.:—(1) Cables—In addition to repairs, allowance for depreciation may be granted at the rate of 3 per cent. per annum on the written-down value. (2) Plant and machinery—On all other plant, exclusive of loose tools, meters, and office furniture, depreciation may be allowed at the rate of 5 per cent. per annum on the written-down value, in addition to the cost of repairs. (3) Conduits—No allowance should be made for depreciation; but annual expenditure on repairs and renewals may be allowed as working expenses, as and when incurred. (4) Meters, loose tools and office furniture—No allowance should be made for depreciation, but annual expenditure on repairs and renewals may be allowed as working expenses, as and when incurred. (5) In all cases where depreciation allowances are granted, a strict account should be kept of the annual expenditure on renewals, including replacements due to obsolescence, and of the amounts allowed for depreciation and obsolescence, whether under this arrangement, or under any arrangement made prior hereto, and a readjustment should be made for the future, if necessary, at the end of every five years, by increasing or diminishing the allowance, as the circumstances require. (6) Where depreciation allowances are granted, renewals should be carefully distinguished, and, if charged against revenue, they should be notified to the surveyor, in order that they may be added back in arriving at the income-tax liability. (7) "Written-down value" means original prime cost, plus subsequent additions, less all allowances actually granted by the revenue in respect of wear and tear. (8) These proposals are to take effect for the year 1908-9, and for years preceding in cases where claims of depreciation are at the present time awaiting settlement; (9) the computations necessary for any future adjustment should be duly made, agreed and recorded each year, whether the accounts for the particular year under review show any accessible income-tax liability or not; (10) where, in any cases, allowances for depreciation have been made which are now to be discontinued, and they have not been exhausted by renewals already effected, the amount of such unexhausted allowances should be determined by agreement between the surveyor and the corporation or company, and deducted from the expenditure on future renewals, as and when they are affected; (11) all cases of dispute should be referred to the Board through the Chief Inspector of Taxes.

SOUTHWARK.—The district surveyor has claimed as his fees for inspecting six electricity junction box chambers, £7 10s. The cost of the construction of the chambers amounted to £7 4s. The fees are to be paid under protest, and the L.C.C. and the Islington Conference dealing with the whole question are to be communicated with.

LEWISHAM.—An application by the South Metropolitan Electric Light and Power Co., Ltd., to erect eight standard arc lamps on the public footway in front of No. 1, Belmont Hill, and Nos. 73-83, High Street, Lewisham (high pavement), has been granted under protective conditions.

FULHAM.—The electrical engineer reports that the boiler extensions have been carried out at an actual cost of £3,616, as against the estimated cost of £3,868. The extensions have proved of the greatest possible benefit; 135 applications have now been received under the scheme for the free wiring and fitting-up of consumers' premises for electric light, and 99 have, so far, been connected to the mains.

Oldham.—The B. of T. has written to the Corporation that it is prepared to entertain the request of the Corporation to supply electricity to premises in Chadderton and in Limehurst rural district, each to form the subject of a separate order. As to Royton's supply, it appears to the Board that a general supply of the nature suggested was not contemplated in the Oldham Corporation Act of 1909, and must be the subject of an application for a provisional order. It now rests with Royton to obtain the order and then to approach the Oldham Corporation.

The borough electrical engineer (Mr. Newington) has presented a report recommending the extension of the plant at the Greenhill generating station, which he holds to be necessary, and the matter has been considered by the Committee. The engineer said the cost to bring the plant existing at Rhodes Bank to Greenhill would be £700, and they would have to put in more boilers. The matter was left over till the next meeting.

Paraguay.—It is reported that Senor Carosio, who has asked for a concession for an electric tramway and power station in Asuncion, has made arrangements for the purchase of the power station of Messrs. Gatti & Co., which supplies the public lighting of the town.—*Review of the River Plate.*

Saltwood.—The Folkestone Electricity Supply Co. has informed the Elham R.D.C. that it is not taking up a prov. order for E.L. at Saltwood, but is only applying for powers to supply in the parish, which is outside its lighting area.

Southend-on-Sea.—The L.G.B., in remitting a disallowance by the district auditor for a sum of £8 2s. 8d. paid to the electrical engineer in respect of expenses in attending a conference of the Municipal Electrical Association at Manchester in June, 1909, intimated that they could not undertake to adopt a like course with regard to any disallowance of similar expenditure in the future.

Local electricians have applied to the T.C. for a special rate for energy used at their business premises for the display of E.L. fittings, &c.

The T.C. has authorised mains extensions at a cost of £792.

Taunton.—The T.C. has arranged with the postal authorities for the laying of a duplicate electric light service to the new post office.

Having regard to the decision in the Leicester case, the T.C. has asked the town clerk to lay before it and explain the position of the Corporation as regards the free-wiring agreements entered into by the Council some years ago. The question, it is stated by the Electricity Committee, cannot affect the Corporation prejudicially, but as the raising of the question, which appears to be of necessity, may lead to litigation, it is incumbent on the Council to receive the explanation from the town clerk in committee, and without any written statement of facts. The Committee has

received authority to deal with the matter, either by enforcing the Corporation's advised position or by a compromise.

Tottenham.—The North Metropolitan Electric Power Supply Co. has agreed to provide and erect five additional lamps and columns with all cables without charge, to continue the electric lighting in a further portion of West Green Road, on condition that the Council undertakes to include any future lamps as coming within the existing contract between the company and the Council, viz., the payment of £16 per lamp per annum. Provision is to be made by the Council in the ensuing half-yearly estimates for lighting the five additional lamps.

Upholland.—The Bispham Hall Colliery Co., who have installed a large generator, and who have surplus plant, have asked the U.D.C. whether it would care to take electricity from them for public lighting. The Council is considering the matter.

Willesden.—As the feeders in the Harlesden area are now practically overloaded, an additional feeder is to be laid from Taylor's Lane to Green Hill Park, at an estimated cost of £1,620. Having considered a letter from Mr. Clift Ford with reference to the lighting of High Street, Harlesden, the Electricity Committee is to make an inspection of the street arc lighting generally in the district. Application is to be made to the L.G.B. for sanction to the following loans for the extension of mains and services during the next three years: Mains, £5,000; services, £3,000; £1,380 is to be spent in main extensions to the Park Royal Estate.

TRAMWAY and RAILWAY NOTES.

Airdrie.—The "fair fare" system has been in operation for some time on the routes of the Airdrie and Coatbridge Co., but has not been too satisfactory, as the company announces its intention of reverting to the old system of charging between section points. The change will take place on New Year's Day, but the sections have been rearranged, the route having been divided into 13 instead of 14 sections as formerly. Farthing charges are to be discontinued, and for any two consecutive sections the fare will be ½d., any four sections 1d., seven, 1½d., and any ten, 2d., the through fare being 2½d.

Argentine. — The Rosario Electric Tramway Co. has forwarded to the Municipality a petition asking for an extension in its concession for 25 years, up to September 15th, 1985. In return, it offers to construct 30 km. of new line in accordance with plans of the Municipality and to increase the line by 10 km. for every increase of $1,000,000 in the receipts. This increase of 10 km. would cease 20 years before the expiring of the concession. It also offers to reduce the fare to a uniform one of 10 cents, to construct a double line in the Avenida Central, to hand over to the Municipality 1,250,000 fr. for the building purposes, and to forego the lawsuit it intended to bring against the Corporation for not having been allowed to construct the line in Avenida Belgrano. According to the directors' report the company works at a loss of $77,678 a year.—*Review of the River Plate.*

Australia.—The Victorian Railways Commissioners have been at considerable pains to procure efficient mechanics for the purpose of installing electric track-locking gear, which is being applied as rapidly as possible to the Melbourne suburban railways, but the supply has proved so small that it has been found necessary to engage six expert workmen in England. The apparatus provides automatic electrical communication between the rails, the signals and the levers in the boxes. Several additional sections of the lines have of late been supplied with the Sykes signalling apparatus, and these installations will be pushed on. In order to avoid the frequent delays entailed by the division of work between the electrical and the mechanical branches of the department, the whole of the signalling work will, in future, be carried out by Mr. F. M. Calcutt, engineer of signals and interlocking.

Barrhead.—On Saturday will be opened the new section of the Paisley Tramway Co.'s line from Barrhead to Thornliebank, where a junction with the Glasgow T.C.'s system will be made. The distance is about 3 miles, and the fare is to be 2d. for the single journey. The new route, which gives Paisley and Barrhead people a clear run through to Glasgow's favourite public park—Rouken Glen—is sure to be largely patronised, particularly in summer.

Bradford.—The Tramways Committee submitted to the City Council last week the new conditions of service and increases of pay for the tramway employés. The Committee recommended the Council to adopt the proposals, which were estimated to entail an expenditure of £4,561 per annum. On the suggestion of the general manager (Mr. C. J. Spencer), the Committee had adopted a proviso that additional pay should not be granted automatically as a right, but only on the recommendation of the manager in individual cases. Mr. Spencer submitted in his report on the employés' application, that the object of increased pay and other inducements for betterment should be educative, and that if increased pay could only be got by effort towards higher efficiency, both employer and employé would ultimately benefit.—Councillor E. Priestley, chairman of the Committee, presented the report to the Council.—Councillor Warne suggested that as members of the Council only received the general manager's report on these recommendations on the previous night, the question should be adjourned for a month, and Councillor Priestley said he left the matter entirely in the hands of the Council.—Alderman Trotter thereupon moved that permission should be given Mr. Priestley to take back the recommendations for a month.—Councillor Leach protested against the withdrawal of such an important series of resolutions. The application of the employés was some four or five months old; it had been carefully inquired into by the Tramways Committee, and the recommendations were arrived at almost unanimously. After paying a tribute to the tramway employés, Councillor Leach pointed out that the last balance-sheet of the department showed a profit of £30,000, a sum which, he understood, would be even bettered next year. It was high time that the Council should recognise the justice of the findings of the Committee. The amendment was defeated by 29 votes to 25, and the report was adopted. The following are the proposals which were ultimately adopted:—Inspectors are to be paid for overtime; the maximum rate of pay for ticket inspectors is to be raised from 36s. to 38s.; the wages of drivers and conductors who have had four years' service are to be advanced a farthing per hour, and those having eight years' service are to be increased ½d. per hour. It has been decided that conductors who have passed as drivers and have acted as conductor-drivers for six months, shall be paid the minimum rate for a driver when employed as either driver or conductor. The wages of handymen, shed labourers and cleaners, are to be advanced from 6d. to 6½d. an hour after 12 months' service. All these men, together with tradesmen, are to have one week's holiday, with pay.

Blackburn. — The returns on the Blackburn Tramway system for the last nine months show a decline of £1,261 on the corresponding period of 1909, and are £2,610 below 1908.

Continental Notes.—FRANCE.—La Compagnie des Tramways de Tours has secured a concession for a proposed electric tramway between Tours and Azay-le-Rideau for the transport of both passengers and goods.

TURKEY.—The Turkish Government has approved the project for the conversion of the tramways in Constantinople to electric traction.

GERMANY.—The Saxon State Railway authorities have just placed a contract with the A.E.G., of Berlin, for the conversion of the railway between Mittweida, Bergstadt and Limbach to electric traction.

SPAIN (BALEARIC ISLANDS).—A concession has been granted to Don Mariano Gual, Conde Ayamanes and Don Alfonso Chopitea, for the construction and working of an electric tramway from Cás Catalá to the station at Palma (Majorca).—*Board of Trade Journal.*

Coventry.—The T.C., acting on expert advice, has decided to proceed with negotiations for the purchase of the undertaking of the Tramway Co. The company has expressed its willingness to enter into negotiations.

Glasgow.—The T.C. at its last meeting discussed at great length the proposals of the Tramways Committee for a number of important concessions to the travelling public. Bailie Russell, the convener, explained that they were proposing to make the experiment with the increase of last year's receipts of £30,000 in hand, so that they were in a very safe position. The Committee's recommendations were approved by a large majority.

At a meeting of the T.C. Committee to consider the Council's decision on the afternoon of Tuesday (December 27th), it was arranged to issue 1½d. tickets, which will enable the passenger to travel two three-farthing stages—each of the latter being two half-penny distances; the following official notice issued will explain the new system:—Beginning on Sunday, January 15th, and until further notice, passengers may purchase a ticket from the conductor for 1½d. which will entitle him to travel two consecutive halfpenny stages, and any two consecutive halfpenny stages in a second car. A passenger wishing one of those tickets should simply say to the conductor "Two stages," which ticket must be retained and handed complete to the conductor of the second car.

Single tickets for the three-farthing stage will not be issued, the object being to obviate the changing of the smallest coin, while under the new system the passengers will escape the purchasing of new tickets in quantities as was originally intended.

Huddersfield.—The U.D.C.'s of Holmfirth, Holme and Netherthong, have decided to support the scheme for the extension of the Huddersfield tramway system from the Honley terminus to their districts.

Keynsham. — The Bristol Tramways Co. has applied for another two years' extension of time for extending the tramways to Keynsham.

Kingswood.—The U.D.C. has decided to oppose the application of the Bristol Tramways Co. for a further extension of time for extending the tramways to Warmley, on the ground that the company is acting against the public interest in withholding the extension.

Leagrave.—Messrs. Balfour, Beatty & Co., Ltd., who are associated with the lessees of the Luton Corporation Tramways, have asked the Luton R.D.C. to support their application for an order to construct a tramway from Luton to Leagrave. The Luton T.C. desires to have the power to acquire the new undertaking at such future time as may be decided upon, on the grounds that, without the Corporation system, the tramway to Leagrave could not possibly exist as an individual unit, and that the area to be served is one which will probably be included within the borough at some

future time. The R.D.C. has decided to place the case before Parliamentary agents.

London.—Camberwell.—Notice has been received from the London Electric Supply Corporation, Ltd., of its intention to lay trunk mains in Queen's Road to Lyndhurst Road. The town clerk has reported that there is a doubt as to the right of the company to go south of the London, Chatham and Dover Railway line in Lyndhurst Road, in order to supply the London, Brighton and South Coast Railway. Unfortunately, its order is not very definite or precise as to the boundary of the area of supply. Permission is to be given for the works to be carried out, subject to protective conditions, and the attention of the B. of T. is to be called to the pressure proposed, in order that the necessary precautions may be taken for the protection of the public.

Morecambe.—The T.C. has decided to apply to the B. of T. for sanction to borrow money for doubling the tramway track from Thornton Road to Bare. This will complete the doubling of the entire track along the Front.

TELEGRAPH and TELEPHONE NOTES.

Australia.—The wireless stations erected five years ago at Queenscliff (Victoria) and Devonport (Tasmania) have been but little used, and the Marconi Co. has offered to sell them to the State. The company proposes to bring the equipment up to date, and to erect a station on King Island.—*Australian Mining Standard.*

Glasgow.—A sub-Committee of the T.C. has had before it a letter to the Telephone Committee of the Associated Chambers of Commerce, in which the Postmaster-General pointed out that it would be impossible to determine what rates would ultimately be necessary for the post office system until the telephone system had been taken over and the price to be paid for the plant under the agreement of 1905 had been settled. The Telephone Committee of the Associated Chambers of Commerce held that the normal number of calls permissible on one line ought not to be less than 10,000, and that for 10,000 calls under the new tariff, with its extras for junction calls, the annual charge would be from £35 to £40. The sub-Committee instructed the town clerk to communicate with other Corporations and public bodies, asking them to appoint representatives to attend a conference at which the whole question of telephone communication and the charges therefor will be discussed, and with Members of Parliament for the city, asking them to support any representations to be made to the Postmaster-General and the Government for the appointment of a Parliamentary Committee to inquire into the whole question of telephone control and charges.

New Cable.—The new German cable from the West Coast of Africa to Pernambuco will be laid by the c.s. *Stephan* early next year; it has been insured in London, according to the *Financial Times*, at a remarkably low rate, owing to the keen competition for this class of insurance business, the amount being £350,000.

CONTRACTS OPEN and CLOSED.

OPEN.

Aldershot.—January 17th. 750 tons of steam coal, for the U.D.C. Electricity Works. See "Official Notices" to-day.

Australia.—January 10th, 1911. Telephone cable, for the P.M.G.'s Department in Victoria. See "Official Notices" November 18th.

January 10th, 1911.—Contacts and condensers, for the P.M.G.'s Department in Victoria. See "Official Notices" November 18th.

January 24th, 1911.—Wire, twisted pair, for the P.M.G.'s Department in Victoria. See "Official Notices" December 2nd.

January 25th, 1911.—Portable petrol-driven winch, for the P.M.G.'s Department in New South Wales. See "Official Notices" December 2nd.

January 25th, 1911.—Insulators, wire, &c., for the P.M.G.'s Department in South Australia. See "Official Notices" Dec. 2nd.

February 1st, 1911.—Testing equipment, for the P.M.G.'s Department in New South Wales. See "Official Notices" December 9th.

February 7th, 1911.—250 indicators, for the P.M.G.'s Department in Victoria. See "Official Notices" December 16th.

March 7th, 1911.—Eleven sections of a branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" December 16th.

March 14th, 1911.—Installation of wireless telegraphy at Thursday Island and Papua, for the P.M.G. of Australia. See "Official Notices" December 23rd.

April 18th, 1911.—One common-battery switchboard, for the P.M.G.'s Department in Western Australia. See "Official Notices" December 23rd.

Birmingham.—January 30th. Stores, for the Corporation Tramways Department. See "Official Notices" to-day.

Cape Town.—March 1st, 1911. Tenders are invited for the installation of a system of ventilation, heating and cooling in the new Law Courts. Information from the architects, Messrs. Hawke & McKinlay, Rhodes Buildings, Cape Town, and the High Commissioner of the Union of South Africa, 73, Victoria Street, London. Tender to the Controller and Auditor-General, Parliament Street, Cape Town.

Denmark.—January 16th, 1911. One 4,000-kw. turbo-generator, with condensing plant, for the municipality of Copenhagen. See "Official Notices" December 23rd.

East Ham.—December 30th. One 1,000-kw. triple-expansion medium-speed steam engine and generator, and one evaporative condenser, with air and circulating pumps, piping, &c., for the Corporation. See "Official Notices" December 9th.

Haslingden.—January 10th. Electric lighting installation at the new infirmary, Higher Pike Law, Rawtenstall, for the B. of G. See "Official Notices" to-day.

Leytonstone.—December 30th. Electric lighting installation at the new County High School, Forest Road, for the Essex Education Committee. See "Official Notices" December 9th.

London.—Islington.—January 12th, 1911. High-tension switchboard for the Borough Council Electricity Works. See "Official Notices" November 25th.

January 10th, 1911.—High and low-tension switchgear. See "Official Notices" December 9th.

Hackney.—January 4th. Installations of telephones in Pavilions A and B, at the Infirmary, High Street, Homerton, and removal of existing installation in Pavilion A, for the B. of G. See "Official Notices" December 16th.

Manchester.—January 9th. The Tramways Committee invites tenders for special (permanent way) trackwork.

Morley.—January 16th. Materials for construction of about 1 mile 7 furlongs of single line of tramways with loops, representing a length equivalent to 2 miles 3 furlongs of single track, and overhead electrical work, for the T.C. Town Clerk, Town Hall (returnable deposit of £10 10s.).

Plymouth.—The Electricity Committee of the T.C. has decided to invite tenders at the close of the current contract, which expires on March 31st, for electricity meters. The present contractors offered to reduce the existing prices if their contract was extended for a year.

Portuguese West Africa.—March 25th, 1911. The municipal authorities of San Thomé, Portuguese West Africa, are inviting tenders for the concession for the establishment of a central generating station for the supply of electrical energy for lighting and power purposes in the town.

Salford.—January 16th. Steam-driven air-lift pumping plant, for the Corporation electricity works. See "Official Notices" December 16th.

Shanghai.—January 4th, 1911. Two turbo-alternators, 2,000 to 2,500 kw., with condensing plant, and four water-tube boilers, with integral superheaters, mechanical stokers, economisers, &c., for the Municipal Council. See "Official Notices" Dec. 9th.

January 18th.—Main H.T. switchboard and auxiliary switchgear for generating station; static transformers and high and low-tension switchgear for sub-station, for the Municipal Council. See "Official Notices" to-day.

Shotley Bridge.—January 9th, 1911. Two high-speed engines and generators, switchboard, battery, and wiring for about 500 lights, at the new buildings on Whinney House Estate, for the Gateshead B. of G. See "Official Notices" December 23rd.

Spain.—The municipal authorities of Campdevanol (province of Gerona) have just invited tenders for the concession for the electric lighting of the town during a period of five years.

Tenders have lately been invited by the municipal authorities of Besalu (province of Gerona) for the concession for the electric lighting of the town during a period of six years.

Switzerland.—January 15th. The authorities of the Chemin de Fer Grand Ducal at Basle are inviting tenders for the supply and erection of four electrically-operated luggage lifts.

Taunton.—2,500-volt single-pole switches and fuses, for the Corporation. See "Official Notices" December 23rd.

Todmorden.—January 11th, 1911. Wiring and fittings for the Town Hall, including conversion of gas chandeliers, for the Corporation. See "Official Notices" December 23rd.

Torquay.—January 11th. Electric light installation at Abbey Road Congregational Church. E. M. Skinner, The Glenkens, Warren Road, Torquay.

Warrington.—January 10th. E.H.T. cable, for the Corporation Electricity Department. See "Official Notices" to-day.

(Continued on page 1071.)

THE CERVARA-NARNI POWER PLANT, ITALY.

By Dr. ALFRED GRADENWITZ.

The large power-transmission plant of the Società Industriale Elettrica della Valnerina, at Terni, in the valley of the River Nera, mainly supplies electrical energy to the electro-chemical factories of the company at Narni.

As regards, first, the hydraulic part of this interesting plant, the intake is situated below the bridge of Papigno. The water passes into an open channel 385 m. in length, 12 m. in average width, 2 m. in depth and 1 0/00 in gradient, terminating in a clearing tank 2,300 sq. m. in area (fig. 1). The clearing tank is traversed by a structure, the upper edge of which reaches 1·80 m. below water-level, and which is intended to prevent any sand and gravel from penetrating into the penstocks, or with open gates, to divert it into the river. Two parallel penstocks, each 520 m. in length and 11 sq. m. in cross-section, lead to an open water chamber, from which conduits lead to 12 sluices in the water compartment. The company had, in fact, at first contemplated installing 12 units of 1,000 H.P. each, but this plan was eventually replaced by another scheme comprising six units of 2,200 H.P. each.

Fig. 1.—Cervara Central Station, showing Conduits.

The following plan was then adopted in order to utilise the existing sluices and admission openings: Each three conduits coming from the water chamber were combined jointly to feed two pressure conduits. While nine connections were thus combined with the six pressure conduits feeding the 2,200-H.P. units, two further connections were used for two existing 1,000-H.P. turbines transferred from an old power-house to the new generating station, and the twelfth conduit was made to feed two exciter turbines. An expansion sleeve and a vertical air chimney, intended to compensate for fluctuations in pressure, are fitted to each conduit.

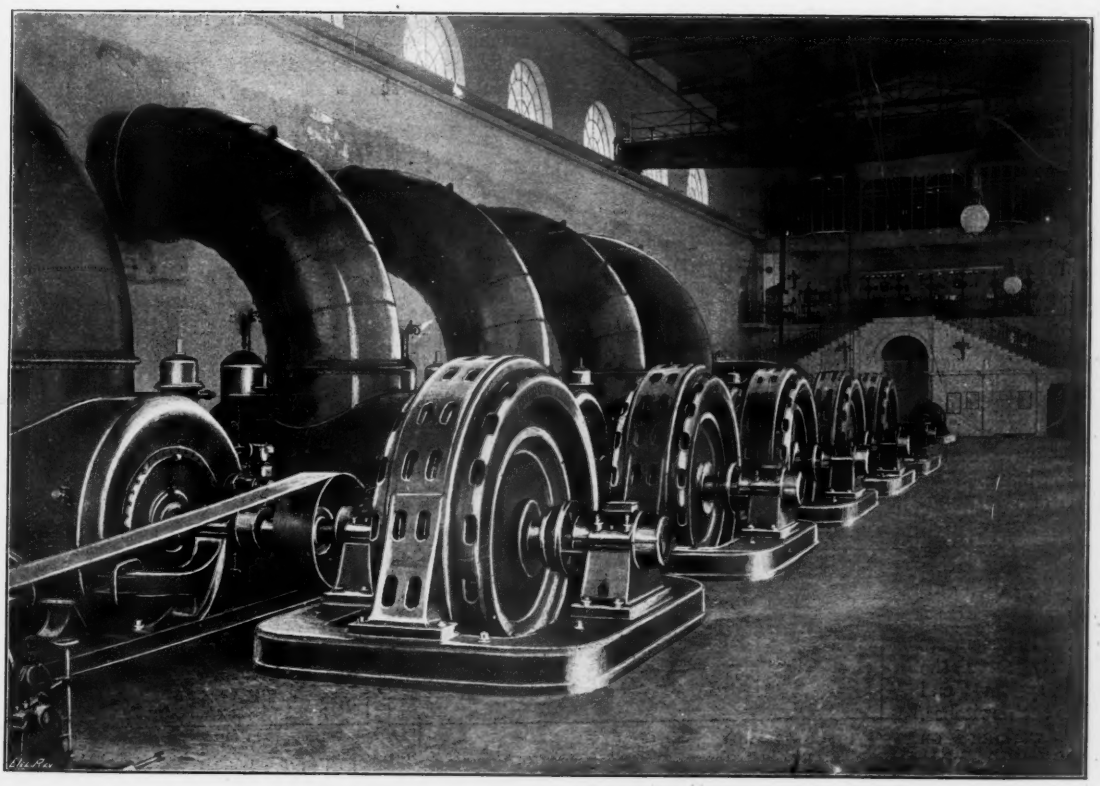


Fig. 2.—Interior of the Cervara Power Station.

The main locking gates of the turbines are hydraulically balanced and are controlled from the generator hall.

The new turbines are of the double-rim reaction type of Messrs. A. Calzoni, of Bologna and according as the head

varies between 19·6 and 23·7 m., absorb each about 10,300—8,700 litres per second, which corresponds to an output of about 2,200 H.P. The generator hall contains at one end the switchboard, and behind this the switchgear and transformer house.

FIG. 3.—27,000-VOLT TRANSFORMER SWITCHES.

The general arrangement of the electrical plant was determined by the fact that two different installations had to be supplied, viz., the 3,750-volt light and power plant of Terni and the Terni-Narni power transmission at 27,000 volts, for operating the carbide factory at the last-named place. In accordance with this idea, there are two self-contained sets of bus-bars.

The generator hall at present contains five three-phase generators of 1,900 K.V.A. each, which are direct coupled to 2,200-H.P. turbines, space being provided for a sixth unit. Furthermore, two generators of 865 K.V.A. each have been transferred from the old power house.

Each of the 1,900-K.V.A. generators can, by means of isolating switches, be connected to either of the bus-bar systems. The two small generators exclusively serve the Terni system and have no such switches. When working on the 27,000-volt bus-bar system, each of the generators is connected direct to a transformer of the same output. These transformers on the H.T. side are connected to the duplicate 27,000-volt bus-bars. Section switches are used to connect the transformers and lines. The Narni Carbide Works are at present connected to the power house by a duplicate three-wire transmission; the Terni transmission is quadripolar with neutral conductor.

The basement of the switch house is taken up by the switchgear of the generators and the series-current regulators. The transformers are located on the first floor, the transformer switches and bus-bars on the second and the line switches and excess pressure discharges on the third floor.

The large generators, with a speed of 252 R.P.M., generate three-phase 42-cycle current, and the normal pressure of 3,750 volts can be increased up to 4,150 volts, The three phases are arranged in star connection, and the fourth conductor, with a view to the Terni lighting plant with its 2,100-volt single-phase transformer, is carried outside by a special terminal. The generators are of the usual design, with stationary H.T. armature and a rotating magnet wheel carrying 20 poles wound with edgewise copper tape. The edges of the pole-pieces are arranged in steps so as to ensure a nearly sinusoidal wave form. The two 865-K.V.A. generators are designed for the same speed and pressure.

Two direct-current generators of 75 KW. each, at a pressure of 120-145 volts and 500 R.P.M., are used as exciter machines. They are driven by special turbines, and will provide for the excitation of all the units after the final extension of the plant to its full capacity. A converter set, comprising a three-phase asynchronous motor of 240 H.P. at 500 R.P.M., fed from the 3,750-volt bus-bars, and direct coupled to a direct-current shunt-wound generator (of up to 1,250 amperes at 120-150 volts) is also provided for excitation.

Each generator panel is isolated by fire-proof partitions, and contains a four-pole oil switch with maximum and reverse-current relay, and the knife switches for connecting the generator to the 3,750-volt bus-bars, or with the corresponding transformer. The oil switches are operated through a rope transmission, from the pillars on the main switchboard. While connected direct with the 3,750-volt bus-bars, the two 865-K.V.A. generators are equipped with the same apparatus as the new units. In the compartment below the switch pillars are located the series-current regulators for the three-phase generators with their carbon switch-outs and the shunt regulators for the exciter machines (fig. 4).

From the basement, the 3,750-volt bus-bars are taken direct into the second floor, and the conductors to each of the transformer calls are arranged on the back of the switchboard, which are accessible from the outside. There are six cells (fig. 5), corresponding with the ultimate capacity of the power house, in which, however, only five three-phase 3,750/27,000-volt transformers of 1,900 K.V.A.

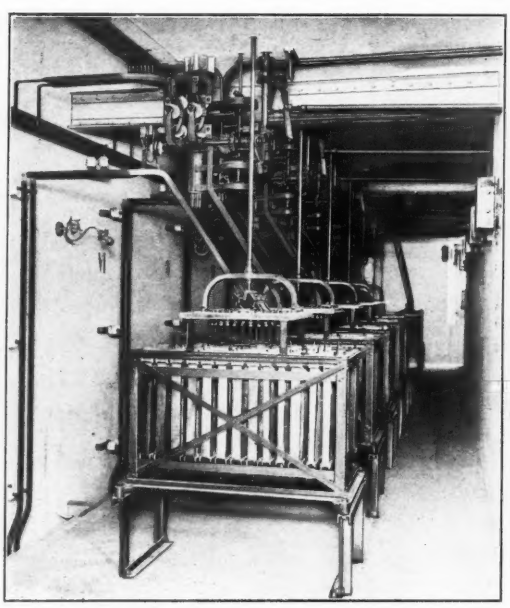


FIG. 4.—SERIES CURRENT AND SHUNT REGULATORS.

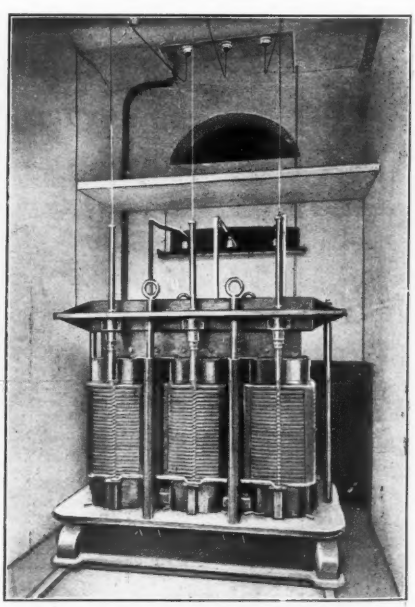


FIG. 5.—1,900 K.V.A. 3,750/27,000-VOLT TRANSFORMER.

each, have been so far installed. The transformer windings are star connected; each winding is self-contained. The L.T. windings are arranged nearest to the cores, and the H.T. windings on the outside, separated from the former by cylinders of impregnated paper with mica inserts.

The transformers are carried on wheels, and can be readily removed from the cells; they are designed for artificial air cooling and lined with sheet metal for guiding the ventilating air. A common compressed-air conduit is arranged below all the transformers, connected to Sulzer fans operated by 10 H.P. three-phase motors. These fans are so designed that either one suffices for cooling all the transformers.

From the transformer cells the conductors are taken to the second floor where transformer switches provided with maximum relays are located (fig. 10). These switches, which can be operated through rope transmission from the switchboard, are designed with the terminals at the bottom, all the operating mechanism being located on the top. From the switches the conductors are taken through three current transformers for actuating the maximum time relay, to a cell system containing the bus-bars and any section switches required.

There are two sets of 27,000-volt bus-bars, one of which serves as reserve; each transformer, as well as the outgoing line, can be connected by section switches to either set.

The current and pressure transformers, and the general ammeters and voltmeters, are inserted between the connections of the transformers and those of the outgoing lines in the 27,000 and 3,750-volt bus-bars. Section switches enable the bus-bars to be short-circuited in case of breakdown, cutting the apparatus in question out of the line.

The outgoing 3,750-volt line for the Terni plant is of the four-pole type with neutral conductor, and is controlled by a four-pole automatic oil-switch with a maximum-time relay, and operated by rope transmission from the main switchboard platform. Horn-shaped spark gaps, each with a slate-tube water resistance and four-pole water jet, are used as excess pressure discharges. A 60-KW. transformer, reducing the pressure from 3,750 volts to 500 volts, is connected to the 3,750-volt bus-bars for dealing with the inside service.

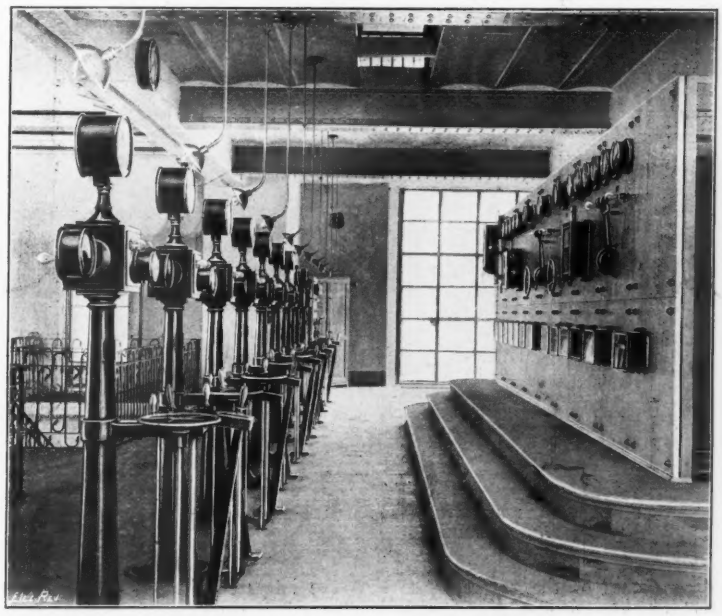


FIG. 6.—MAIN SWITCHBOARD, CERVARA POWER PLANT.

The 27,000-volt line intended for the Narni plant comprises two three-wire transmissions, and is controlled by an automatic maximum oil switch designed for electro-magnetic remote-control from the switchboard (fig. 7). The relay is actuated and the line ammeters are fed through three current transformers. Each outgoing wire is equipped with an induction coil, and protected against atmospheric discharges and excess voltage by a horn-shaped spark gap with four series-connected water resistances and one water jet apparatus.

The main switchboard (fig. 6) comprises all the appa-

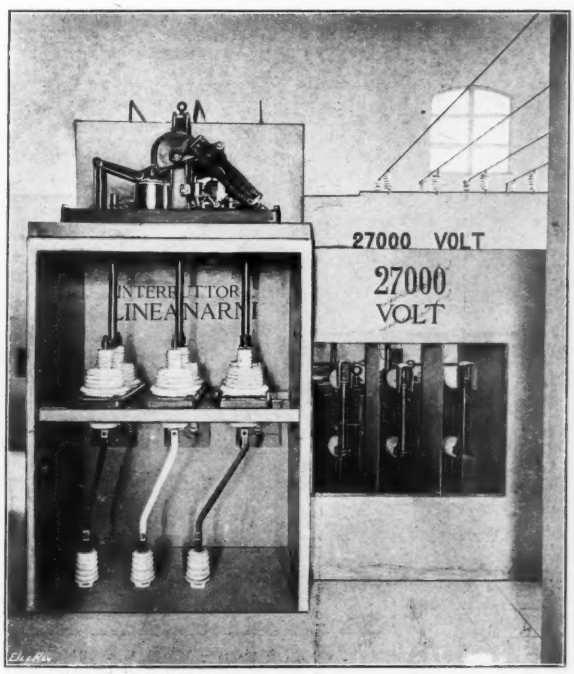


FIG. 7.—REMOTE-CONTROLLED SWITCH ON THE NARNI TRANSMISSION LINES.

FIG. 8.—SPARK GAPS AND WATER RESISTANCES.

ratus and measuring instruments required for controlling the plant. The instruments, operating levers, &c., of the generator sets are located on switch pillars, while the switchboard proper is equipped for controlling the outgoing lines. Each of the five switch pillars for the 1,900 K.V.A. generators carries a hand lever for the automatic generator oil switch, a hand lever for the automatic transformer oil switch, and hand wheels for the series-current regulator in the exciter circuit and the carbon switchout of the exciter. The exciter switches are mechanically interlocked with the main switches of the generator, so that the latter can be closed only after excitation, while the exciter switch can only be opened when the main switch is open. A signalling device comprising incandescent lamps is provided, as with the automatic switches the operator cannot ascertain at the switch pillar whether the switch is in the "on" or "off" position.

On the side of the pillar towards the machines is mounted a phase lamp for signalling to the turbine operator. The switch pillars for the two 865-K.V.A. generators are equipped in the same manner, but without the lever of the transformer switch. Another pillar contains the apparatus for the converter set. The two small turbine-driven exciter machines are controlled from a common switch pillar with two hand-wheels, two levers, two ammeters, and a volt-meter with three-pole volt-meter switch.

The left-hand half of the switchboard is set apart for controlling the Narni, and the right-hand half for the Terni plant; the upper panels provide for operating the line oil switches, for testing, battery regulation, &c. The lower part of the board comprises the relays for the lines, transformers and generators.

The Cervara-Narni transmission line is 14 km. in length and comprises six wires 7·2 mm. in diameter, located at 90 cm. apart. Throughout the installation iron framework poles are installed at about 100 m. apart. The lower wire is suspended at from 7·25 to 9·30 m. above the ground.

The Narni transformer station, which is shown in fig. 11, comprises a transmission tower and the transformer house. The tower contains, on the second floor, the horn-shaped spark-gap and water resistances, and on the third floor, any induction coils and water-jet apparatus for the six poles of the incoming line. The automatic maximum oil switch is located in the basement of the tower (fig. 12), where also is a small marble switchboard with indicating instruments and eight two-pole maximum relays.

The transformer station is a rather lengthy building, containing on one side the transformer cells and on the other side (separated by a wide passageway) the transformer switches (fig. 13). From the 27,000-volt bus-bars, which traverse the whole length of the room, connections are branched off to the various transformer switch cells. Each of these cells contains a maximum oil switch and time relay; the transformers are designed for artificial air cooling, their L.T. terminals being connected direct to the carbide furnaces. A line branched off from the 27,000-volt bus-bars feeds two transformers for the internal service and lighting of the works.

All the electrical machinery of the Cervara power house, as well as of the Narni transformer station, was supplied by the Oerikon Machine Works, to whose courtesy we are indebted for the particulars embodied in the present article.

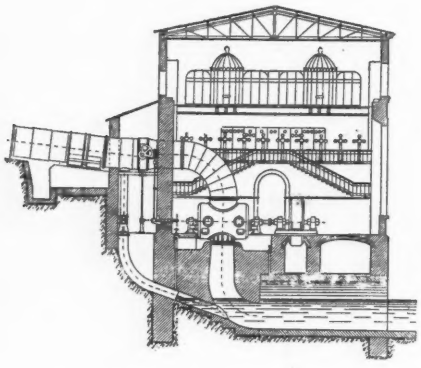


Fig. 9.—Section showing Turbine Arrangement.

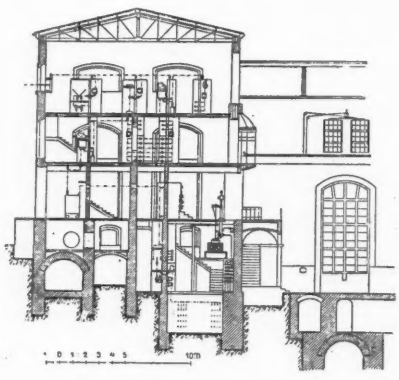


Fig. 10.—Section through Switch-House.

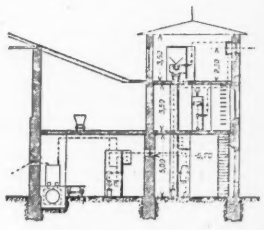


Fig. 11.—Narni Sub-Station.

Fig. 12.—Main Switch on Incoming Line. Narni Transformer Station.

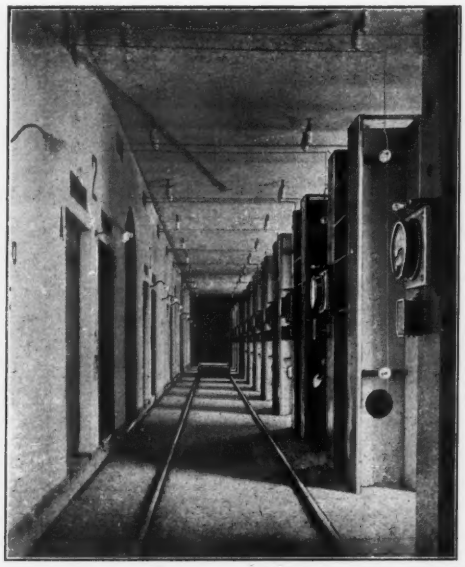


Fig. 13.—Operating Pathway.

Carlisle Electric Lighting.—At a meeting of the T.C. on the 20th inst., a resolution was adopted that the T.C. make application to the Board of Trade for a provisional order authorising the Corporation to supply electricity within so much of the district of the Carlisle R.D.C. as lies within a radius of two miles from the Cathedral. Dr. Overton, who moved the adoption of the resolution, said the estimated cost was £2,300, and the proposed area would take in the villages of Cummersdale, Harraley, Botcherley, Stanwix and Edentown.

CONTRACTS CLOSED.

Australia.—The *Australian Mining Standard* states that the Euroa (V.) Shire Council has accepted the tenders of Messrs. Hornsby & Son for an 80-H.P. engine and suction gas plant, and of Messrs. Warburton, Franki & Co. for the electrical plant. The scheme will cost about £2,700, and will be completed within six months.

The same exchange says that for the Railway Department at Victoria Messrs. W. T. Henley's Telegraph Works, Ltd., are to supply 20 miles of lead-covered impregnated paper-insulated cable, at £38 12s. per mile.

Barnsley.—The T.C. has accepted the tender of the Tudor Accumulator Co., Ltd., for replating the traction battery, at £556.

Belgium.—It is with much pleasure that we record the fact that a British concern, Callender's Cable and Construction Co., of London, has succeeded in submitting the lowest tender to the Société Nationale des Chemins de Fer Vicinaux, of Brussels, for the supply of the armoured underground cables required in connection with the light electric railways in the Louvain district, and for the laying of the same and for the fixing of the necessary rail returns. The British success is all the more noteworthy because of the great competition for the contract, no fewer than seven German firms and one French firm submitting tenders.

Bradford.—At the last meeting of the Tramways Committee the following tenders were accepted :—

Hadfield's Steel Foundry Co., Ltd.—Manganese-steel crossings required at Manchester Road and Great Horton Road junction, £595.
Messrs. John Spencer, Ltd.—Steel tube for bracket arms, £118.

It was also decided to obtain an oxy-acetylene cutting and welding plant on approval.

The following are among the successful tenderers for miscellaneous stores for the year ending December, 1911 :—

British Thomson-Houston Co., Ltd.—Insulated material, ½-in. and 1-in. P. and B. tape.
General Electric Co.—Chatterton compound.
George Hattersley & Sons and M. Goggin.—Tapes.
W. F. Dennis & Co. and F. Smith & Co., Ltd.—Wires.
Dyer & Young.—Copper controller contacts.
Carr Bros.—Insulated bolts and strains.
Pinchin, Johnson & Co.—Ferric oxide and dry colours.
A. Illingworth & Co.—Orange shellac leaf.

Falkirk.—The Corporation E.L. Committee has accepted the following tenders :—

Aiton & Co.—Steam piping.
Sharp & Co.—Pump piping.
British Electric Transformer Co.—Transformers.
Key Engineering Co.—Cable conduit.
Dewrance & Co.—Three-way cock.

Glasgow.—The tender of Messrs. Bennett & Rutherford, of Glasgow, has been accepted for the electrical installation in the new offices of the School Board.

London.—WESTMINSTER.—The City Council has accepted the tender of Messrs. Girdlestone & Co., at £26 10s., for repairs to the electric light fittings at Monck Street depôt; also that of Messrs. Drake & Gorham, Ltd., at £35, for substituting metallic-filament lamps for carbon lamps at the Caxton Hall.

Luton.—The T.C. has renewed for a year the contract with Messrs. Macintosh & Co., Ltd., London, E.C., for cables.

Mansfield.—The T.C. has accepted the tender of Mr. Bernard Meggitt for electric cable for the sewage works, at £120.

Southend-on-Sea.—The T.C. has accepted the following tenders :—

Ledward & Beckett.—Distilling plant, £136.
Crompton & Co., Ltd.—Balancer, £254.
Chloride Electrical Storage Co., Ltd.—Traction booster, £523.
Morris & Bastett.—Overhead crane and blocks, £47.
Boydell & Co.—Feeder and network pillars, £135.
Callender's Cable & Construction Co., Ltd.—Disconnecting boxes, £29.
Brush Electrical Engineering Co., Ltd.—Lengthening four single-truck cars, increasing seating capacity from 38 to 58, £1,140.
Reason Manufacturing Co., Ltd.—100 sets of E.L. lamp brackets and fittings, 13s. each.

Walsall.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for a boiler, at £1,189.

Walthamstow.—The U.D.C. received the following tenders for the supply, delivery and erection of turbine generators and condensing plant at the electricity works :—

Belliss & Morcom, Ltd.; British Thomson-Houston Co., Ltd.; Brush Electrical Engineering Co., Ltd.; Fraser & Chalmers, Ltd.; The General Electric Co., Ltd.; James Howden & Co., Ltd.; Maschinenfabrik Oerlikon; P. J. Mitchell; C. A. Parsons & Co.; Richardsons, Westgarth & Co., Ltd.; Willans & Robinson, Ltd.; British Westinghouse Co., Ltd.

The tender of the Brush Electrical Engineering Co., Ltd., at £6,371, was accepted.

The Council has accepted the offer of Messrs. Chamberlain and Hookham to fix ampere-hour meters on the whole of the Council's cars, on approval, for a period of six months, free of charge to the Council, and at the makers' risk, the Council to have the option of purchasing or returning them at the expiration of the period named.

FORTHCOMING EVENTS.

Royal Institution.—Saturday, December 31st. At 3 p.m. Lecture on "Sound," by Prof. S. P. Thompson. (Lecture II, "Transmission of Sound.")
Tuesday, January 3rd. At 3 p.m. Lecture, adapted to a juvenile auditory, on "Sound," by Prof. S. P. Thompson. (Lecture III, "Reception of Sound."

Association of Mining Electrical Engineers (South Wales Branch).—Saturday, December 31st. At 3.30 p.m. At the Hotel Metropole, Swansea. Resumption of discussion on "The Inspection and Repair of Electrical Plant Underground." Paper on "Electricity in New South Wales Collieries," by E. K. Scott.

NOTES.

The Compliments of the Season.—The ELECTRICAL REVIEW wishes its readers everywhere a happy and prosperous New Year in 1911.

Electric Lighting Loans.—The voluminous statistics just issued by the Local Government Board for 1909-10 state that £821,584 was authorised to be borrowed by Urban Councils under the Electric Lighting Act, 1882, and £13,484 by Rural District Councils. The following statement shows the amounts sanctioned for the purposes of the Electric Lighting Act, 1882, during the last 20 years :—1890, £62,500; 1891, £115; 1892, £315,545; 1893, £773,722; 1894, £357,886; 1895, £515,543; 1896, £796,588; 1897, £964,837; 1898, £1,058,164; 1899, £2,390,235; 1900, £3,023,692; 1901, £3,995,459; 1902, £2,736,673; 1903, £1,938,775; 1904, £2,134,623; 1905, £1,058,462; 1906, £802,678; 1907, £1,247,781; 1908, £1,377,268; 1909, £835,068; total, £26,385,614. The whole of this amount was required by Town Councils and Urban District Councils, with the exception of loans amounting to £20,000, £7,000 and £13,484 sanctioned to be raised by Rural District Councils in 1905, 1908 and 1909 respectively.

The authorities to which loans were authorised during the year under review were :—

Aberdare	£16,797	Leyton	£4,485
Barnsley	2,955	Liverpool	68,000
Bath	8,688	Llandudno	2,450
Beckenham	486	Longton	1,740
Bedford	630	Loughborough	1,788
Bexhill	1,990	Lowestoft	3,822
Birkenhead	20,000	Luton	11,573
Birmingham	117,000	Maidenhead	3,751
Bolton	15,000	Maidstone	19,550
Bridgend	2,340	Manchester	79,470
Bridlington	5,031	Mansfield	3,500
Bristol	695	Mexborough	4,486
Burslem	7,535	Middlesbrough	18,150
Burton-on-Trent	3,650	Newcastle-under-Lyme	700
Buxton	998	Newport (Mon.)	4,078
Cardiff	26,650	Nuneaton	300
Carlisle	6,399	Oldham	11,250
Chester	5,838	Pontypridd	12,044
Cleckheaton	1,981	Radcliffe	13,129
Darlington	3,517	Reigate	1,521
Dartford	1,780	St. Helens	9,725
Derby	52,197	Sale	300
Devonport	6,329	Salford	5,490
Dover	7,519	Sheffield	56,000
Dudley	3,166	Southampton	3,600
Fleetwood	20,967	South Shields	3,735
Gillingham	2,804	Surbiton	3,457
Gravesend	5,750	Wakefield	218
Great Yarmouth	3,074	Walthamstow	2,396
Handsworth	5,313	Watford	6,567
Hastings	5,602	West Bromwich	2,000
Hereford	7,038	West Hartlepool	3,000
Heston and Isleworth	5,545	Whitehaven	1,655
Hornsey	6,000	Worcester	5,752
Keighley	3,325	Worthing	3,750
Kendal	1,976	Wrexham	4,385
Kettering	2,000	York	30,203
Kingston-upon-Hull	11,190	Llandaff and Dinas	2,960
Kingston-on-Thames	5,472	Neath	10,524
Leicester	6,537		

At the end of the year 1907-8, the total amount of loans outstanding of local authorities for electric lighting was £28,666,541.

Italian Hydro-Electric Works.—The increasing development of large hydro-electric works in Italy has led to the disappearance of many small installations, and various companies mainly devote themselves to production, leaving the work of distribution to others. As mentioned by an Italian correspondent of a German newspaper, the larger the companies are individually, the more are useless competitive networks avoided. The north of Italy is dominated by large undertakings in districts. Thus, the Alta-Italia disposes of energy produced in six stations, partly in the town of Turin and partly in the north-east of Piedmont; the Conti Co., which carries on six water-power and three steam-power stations, supplies the districts of Novara, Pavia and Monza, and is able to furnish 200,000,000 KW.-hours per annum; and the Società Lombarda deals with the industrial district of the upper province of Milan, and has 600 works employing 60,000 workers connected with its network; whilst the most extensive area, although but little developed from a manufacturing point of view, is that con-

trolled by the Societá Bresciana. The best example of financial combination is represented by the Edison Co., which is interested in 18 companies, controls the Bonti Co., and has a great influence in the Adamello group. In the districts separating the gigantic undertakings are to be found small companies which seek to maintain their independence, but which are not favourably situated. Water-powers have been developed in Lombardy in recent times without knowing where to dispose of the energy, and as a consequence one company or another threatens to compete in a neighbouring district unless the local company agrees to accept a supply in bulk. As a result of the increased rivalry, the conditions and prospects of hydro-electric works are no longer as favourable as was the case formerly, as over-production is now threatened, especially in Lombardy. This district, on the completion of the works in progress, will have for disposal a maximum of 340,000 H.P., or almost half the output of all the hydro-electric works in Italy; the network is very extensive, and even distant places where merely a few glow lamps are installed are connected, and place a burden upon working. Yet other schemes are reported to be in contemplation, notwithstanding that the area is already, as is said, saturated with electricity. The large consumers of power now pay prices which are declared to scarcely cover the cost of production, and the companies have to look for profits to small users of power and the lighting load. It is calculated that within a short time a total amount of £24,000,000 will have been invested in the Italian hydro-electric works, although it is difficult to say what interest this large sum will yield. The old companies which work favourable concessions and were able to provide for depreciation when supply prices were high, have been able to pay large dividends, and even the old distribution companies have afforded a good return after overcoming the initial difficulties, but the prospects of the newer companies are less favourable owing to the increase in competition and the fall in charges for current, whilst uncertainty exists as to whether the State will acquire the undertakings on the expiration of the concessions after 30 years.

Installation Monopoly in Germany.—The Prussian Ministers for Home Affairs, Trade and Agriculture, recently issued an order to the local anthorities and the police to take steps to prevent, as previously mentioned in this journal, the establishment of an installation contract monopoly in connection with the erection of bulk supply stations, it being considered that free and open competition should prevail in the interests of the community. Whether the order will be of any practical advantage to the installation contractors as compared with the large manufacturing firms, is a question which can only be decided in the course of time, but no attention has been paid to the matter in regard to the recent formation of the Belgard Overland Central Station Co., which has been constituted with a share capital of £192,000. The management of the station have, for instance, issued a notice in a Koslin newspaper announcing that the following firms have been admitted to carry out installations in connection with the central station :—

1. Stettin Technical Bureau of the Siemens-Schuckert Works.
2. Stolph Technical Bureau of the Siemens-Schuckert Works.
3. Stettin Installation Bureau of the A.E.G.
4. Dantsic Installation Bureau of the A.E.G.
5. Bergmann Electricity Undertakings Co., Berlin.
6. Koslin Machine Works, Koslin.
7. Katz Machine Works, Schivelbein.

It will be seen that, in addition to the three Berlin companies, only two local firms have been authorised to carry out work. The non-observance of the Ministerial order in this instance is considered by a Berlin newspaper to be very strange, as the Belgard Central Station by no means represents a purely private enterprise. On the contrary, the promoters or founders include various State authorities and State corporations such as the Pomeranian Provincial Union, the districts of Belgard, Bublitz, Koslin, Kolberg and Schivelbein, the communal authorities of Koslin and the Pomeranian Provincial Co-operative Fund. It may be assumed that the Union of Electrical Installation Firms and the Association of Speciality Works will again approach the Government on the question of monopoly of installation work in respect of connections with central stations.

Stain for Storage-Battery Shelves.—When wooden shelves are to be used for storage batteries, engineers often desire some good coating or treatment for the wood which will preserve it from the acid or alkali used. Wood seems, moreover, to be the most satisfactory material for such a purpose, since metal is so easily corroded, even when heavily coated with such protecting coatings as asphalt paint. Ordinary paint on wood becomes brittle and is apt to spall off, leaving the surface exposed to the corroding influences.

A treatment which has been used for a number of years on the desks of chemical laboratories has been found very satisfactory for storage battery shelves and supports. It gives the wood a beautiful satin-like black finish, and not only makes it resist the action of acids and alkalis, but also raises the ignition point, so that it becomes, in a sense, fireproof. The stain is the well-known aniline black, which is produced in the fibre of the wood by alternately applying the following two solutions :—

Solution A.—This is made by dissolving one part by weight of aniline hydrochloride or chlorhydrate, and one part by weight of sal ammoniac (ammonium chloride), in six parts by weight of water, warmed if necessary.

Solution B.—This is made by dissolving two parts by weight of blue vitriol (copper sulphate), one part by weight of chlorate of potash, in 12 parts by weight of water, warmed if necessary.

The surface of the wood should show a freshly planed surface and be free from oil, which would prevent the solutions from soaking in properly. Solution A is first painted over the dry surface and allowed to soak in and dry thoroughly. Then a coat of B is applied. Two more coats of each are alternately applied in this way, and are usually sufficient. It is important that the drying should not be too rapid, otherwise the solutions do not penetrate the wood as they should. After the above treatment the surface takes on a yellowish-green tint, and is covered more or less with small crystals from the evaporated solutions. Soap, usually in the form of soap powder, is next sprinkled over the surface wet with water and scrubbed thoroughly, and the surface washed off with plenty of water. This soaping brings out the brilliant black colour. When dry, raw linseed oil is rubbed well into the surface.

The acid and alkali-resisting quality of this stain is doubtless due most particularly to the pore-filling copper soap which protects the wood beneath by being, in a sense, water-repelling. It does not, in consequence, allow the surface to become wet with corroding liquids. The solutions keep very well in stoppered glass containers.—F. Bonnet, in the *Electrical World*.

A Peep at Paradise.—

The other night I dreamed a dream
  Of wondrous realms of bliss,
Where salesmen mopped up all the cream,
And buyers had to work full steam
  Their chances not to miss.

For in this land of phantasy
  No makers need compete,
Or cut their prices plumb in three,
Or grovel down on bended knee.
  That scheme was obsolete!

No! Every now and then they'd build
  A generating set,
And then this autocratic guild
Announced the fact, sat down, and filled
  Their tankards up with wet!

And straightway came a horde of those
  Who itched to buy the stuff—
All dolled up in their Sunday clothes,
With humble mien and servile pose,
  Prepared to hand out guff.

Meanwhile the salesman sat at ease
  Within his hallowed den,
While buyers sought the palms to grease
Of office boys, and proffered fees
  To pensioned army men!

But independent was the mien
  Of stalwart Cerberus;
His optic showed no tinge of green,
"First come, first served," the rule, I ween,
  Ceteris paribus.

And when from out the waiting crush
  Was picked a favoured one,
His first inspired, persuasive gush
Was quieted to a vesper hush
  Ere yet 'twas well begun.

For thick and fast the questions came
  From off the great one's tongue:
"Are you prepared to take the blame,
And keep all tarnish off our name,
  If e'er the thing goes bung?

You don't intend to parallel
  With other makes of gear?
You'll have the plant looked after well?
Why! Once a careless craneman fell
  (Due to a taste for beer)—

"And there was all the rotor bent!
  And laminations burred!
What! do I gather that you meant
To overload it ten per cent.?
  Great Scott! The thing's absurd!"

Another one he greeted thus:
  "Now, Sir! I understand
The last machine you had from us
You smashed—no more!!" And then he'd cuss
  And swear to beat the band.

Enjoyment thrilled through all my soul,
  Each vein with rapture ran,
Inverted thus to see the *rôle*
I play each day to earn my dole.
  (I am a maker's man!)

* * * *

Whoop! Crash! I woke, rememb'ring clear
  How, just the day before,
A huge consulting engineer,
With smug, exasperating leer,
  Had hoofed me from his door!

MUDRÉTZ.

Institution and Lecture Notes.—Institution of Electrical Engineers (Glasgow Local Section).—The ninth annual dinner of the Local Section was held in the Grosvenor Restaurant, Glasgow, on 14th inst., when Mr. Sam. Mavor presided over an attendance of about 200 gentlemen. The toast of "The Imperial Forces" was proposed by Prof. Barr, Glasgow University, who said that while there had been advances in all branches of the naval service, the electrical side was the one which had shown the most definite progress; Mr. Wordingham had effected quite a revolution in the equipment of their ships.—Sir J. H. A. Macdonald, the Lord Justice Clerk, who replied, said that Britannia ruled other "waves" now, and he wondered what Wellington and Nelson would have done if they had been pursued on land or sea by wireless messages from Whitehall. He hoped they would have found a way to avoid them.—Sir H. S. Stewart, in proposing "The Corporation of Glasgow," expressed his admiration for what electricians had accomplished in the past, and his confidence of their achieving greater things in the future. Sir Hugh said that within the last few months—since the successful Smoke Abatement Exhibition in the city—the Corporation had put electricity within the reach of all for heating and cooking purposes. By the progress they had made in Glasgow through the use of electricity for power they had displaced 60 to 70 great boilers.—Bailie Archibald Campbell, who responded, pointed out that the electricity supply department had now a capital of £2,250,000, while the revenue for light and power during the past year was £260,000. The price of electricity was now 2½d. for lighting and less than 1d. for power. This meant much in the battle against a foul atmosphere. Their total motor load now ran to an aggregate of 33,000 H.P. The toast of "The Institution of Electrical Engineers" was proposed by Sir Donald MacAlister, K.C.B., Principal of Glasgow University, who complimented the Institution on its acquiring a home of its own. While electricity had penetrated into every part of their civic and domestic life, he wished it would penetrate further and abolish the domestic fire-place, and so give them as pure air as they had at Greenock, for example! Mr. S. Z. de Ferranti, who responded, complimented the Glasgow members on what they had done in the immense growth and development of the electrical industry. The development heretofore, he was sure, would be nothing when compared with what they would yet accomplish in the future. The time was coming when not only electrical engineers, but all engineers, would find it difficult to get along without a considerable knowledge of electrical engineering. The developments which were now taking place would add to the importance of their Institution and put it in the front rank among the scientific societies of the world. They must all do their part in advancing the interests of the Institution; so would their Institution continue to be looked up to, and men would come to feel that membership with them was a thing to be valued. They felt that the time had come when they must assist original research, scientific research, in electricity. They felt now in the spirit of the time that they required to work co-operatively. He was sure that in the hands of those present and the other members there was no doubt as to the success which would be achieved. Mr. W. H. Patchell, member of the Council of the I.E.E., gave the "Glasgow Local Section." He complimented the chairman on the work his family had done as pioneers in local electrical work. In his reply, the Chairman recalled that the system of supply advocated by Mr. Ferranti for Glasgow many years ago, and abandoned at that time, was the system upon which the later growth of electric supply had been founded. A musical programme was submitted during the evening.

Association of Mining Electrical Engineers.—A general meeting of the West of Scotland Branch of the Association was held on Friday, 16th inst., to consider the syllabus which the Branch should put forward to the Council as a provisional scheme to form the basis of examinations for certificated membership. The recommendations, briefly outlined, were to the effect (1) that the scope of the examination be limited to the theory and practice of electrical engineering, and should not include special mining knowledge, excepting, of course, a thorough acquaintance with the special rules for the use of electricity in mines; (2) that the examinations be graded, and that there be only two grades for the present; (3) no candidate under the age of 21 years should sit for the second class, and no candidate under 23 years of age for the first-class certificate. Further, candidates should not be admitted to an examination unless they could show that they had served three years as apprentices, improvers or journeymen in the electrical and mechanical department of some electrical engineering undertaking and two years as practical electrical engineers or electricians in mining work. Under certain conditions alternative training might be accepted; (4) the examination should consist of written and oral tests in theoretical and practical work, with a practical examination in installation, testing and repair work; (5) examiners for the practical and oral examination should be selected from candidates nominated by the local council in the district. A discussion followed on the paper contributed by Mr. R. R. Smith, on "Inspection and Repair of Electrical Plant Underground."

Institution of Electrical Engineers (Yorkshire Local Section).—At the University, Leeds, on Wednesday, January 11th, at 7 p.m., an address will be delivered by Dr. Henry Stroud on "Radio-Telegraphy," with special reference to the experimental wireless telegraph station at Armstrong College, Newcastle. The address will be illustrated by experiments and lantern slides, and recent developments in wireless telegraphy will be dealt with.

Mining Institute of Scotland.—At a meeting, last week, a paper by Messrs. Robert Crawford and Harold Moores on "Power Production at Collieries, with Special Reference to Gas Power and Electrical Centralisation," was read and discussed. An interesting paper on "Recent Progress in Mining Switch-Gear" was read by Mr. George Stevenson.

At a meeting of the Notts. Mining Students' Association a paper on "Electrical Engineering" was given by Mr. Hickman, of Ripley (under-manager at Pentrich Colliery), in the course of which he touched upon the advantages of electricity in connection with coal mines, and mentioned that there were to-day 777 electric coal-cutting machines being worked in coal mines in England. Some 80,000 persons were connected with the working of these machines, and out of 23 persons who had lost their lives whilst working these machines, nine deaths were caused through the ignition of gas by electricity.

In a paper on "Electric Driving in the Textile Industries," read before the members of the Keighley Textile Society, Mr. Nasmith, of Manchester, detailed a number of the advantages which are obtained by its employment. The evidence in support of these claims was given in full, and in dealing with the increased production gained by driving textile machinery, he said that on the average 10 per cent. increase would be obtained from looms and from 7½ to 10 per cent. from spinning machinery. Steam driving was then compared with electric driving, and the lecturer showed how by electric driving a considerable saving could be effected.

Sterilisation of Water by Ozone.—The largest ozone installation yet carried out for the purification of water has just been inaugurated at St. Petersburg, at a cost of £150,000. Receiving water from the Neva, the plant passes it through filters and then through an ozonising apparatus, which destroys all deleterious organisms. The magnitude of the installation, which has been carried out by a German firm, clearly demonstrates the growing importance of this means of purifying water for town supply.

Blast-Furnace Gas as Fuel.—It is mentioned in the annual report of Siemens Elektrische Betriebe, that the negotiations for the purpose of securing a concession to establish an overland central station near Lubeck were concluded last January. The fuel to be used in the station is blast-furnace gas from the Lubeck blast furnaces, which belong to a company in which the State or town of Lubeck is largely interested. Long term contracts have been entered into for the supply of electricity to the towns of Lubeck and Wismar, and the opening of the station is expected to take place early in 1911.

Fatalities.—At an inquest that was held on Saturday at Middlewich by Coroner Yates on the body of Harvey Worrall (14), electrician's apprentice at the Electrolytic Alkali Works, evidence was given to show that the deceased was assisting an electrician named Harry Marsh to do some wiring in the lime house. While Marsh was working, the lad got hold of a piece of wire and was holding it to a revolving shaft with which he seemed to be fascinated, although he had been warned several times to keep away. He had traced a worm on the shaft with his finger, the shaft itself being covered with lime. For the fourth time the deceased went to the shaft while the electrician's back was turned, and finally he seems to have gone to the shaft with the wire securely fastened round his fingers. Marsh was alarmed to hear a thud against the wall and a scraping on the floor, and found the apprentice wrapped tight on the shafting. He immediately switched off the motor and then saw that the lad's head was fearfully battered and the right arm torn off. He seemed to have coiled the wire tightly round his fingers and could not therefore get loose when the wire had caught in the shafting. It was stated that the shaft of itself did not constitute a danger, but Mr. J. T. Irwin, the general manager of the company, intimated that they intended to box it in. A verdict of "Accidental Death" was returned.

At Ossett, on December 20th, an inquest was held into the death of a young man named Sydney Henshall, which occurred at the Ossett sub-station of the Yorkshire Electric Power Co., where he was employed. According to the evidence of Mr. James Nelson, the superintendent of the company's operation department, deceased's duty was to run the sub-station. There were two cables in the sub-station alive at 10,000 volts, and they were controlled by one feeder switch on each cable. Witness told the deceased and two others to be at the sub-station on Sunday morning for the purpose of cleaning. They had candles for light, and it was not usual to wear gloves when cleaning, as they only did cleaning on the board when the cables were dead. The bus poker was used for touching the bus-bars after the cables had been made dead, to make sure that the bars were dead and that there was no residual current, but in doing that they stood on a rubber mat and wore rubber gloves. Max H. Hind, assistant to the operation superintendent, said there was no question that the deceased heard what he was told. After Henshall had taken the switches out he put the poker across the switch tails as an extra precaution. He had no gloves on at the time. They had proof that the bars were dead in the fact that the lights went out. The poker was as useful as any other piece of metal, and if there had not been the poker there would have been a wire or other piece of metal long enough to reach across the three tails. Witness saw Henshall with the poker in his hand at the far end where the tails of No. 1 cable were, and seeing him with the poker held as if to touch them, witness shouted, "Don't touch those, they are alive," but it was too late to prevent him. Witness saw him make the contact. There was a flash, and he fell backwards with a groan against the window, and slid to the floor. He was unconscious and groaning, and the poker was not in his hand then. Witness thought the burn mark on the deceased's forehead would be caused by the flash. He could not account for deceased touching the tails, which were actually the only parts that were alive.

The foreman of the jury suggested that as part of the cleaning had to be done in a crouching position, Henshall might have raised his arms to stretch himself after getting up.—Witness did not think that was so.

Dr. W. L. R. Wood said he was called to the station about 2.20 on Sunday morning. Deceased was very blue, but there was no mark of violence. There were some small marks or burns on the right side of the forehead, and he thought death was due to paralysis of the heart, due to electric discharge.

The manager, in reply to the Coroner, said the deceased would get a voltage of 7,000.

The Coroner, summing up, said it seemed that the fatality had occurred through momentary forgetfulness on the part of the deceased, for though he appeared up to that moment to be fully aware of the state of things and of the danger, yet he touched the wire with fatal consequences.

The jury agreed to a verdict that the deceased met his death through receiving an electric shock by touching a live wire in a moment of forgetfulness.

The jury suggested to the company that an instrument with insulated handles should be provided for use instead of the poker, and Mr. Perkins undertook that the company should consider this recommendation.

Before Sheriff Armour Hannay and a jury at Kirkcaldy, an inquiry took place regarding the death of a machineman who was drawn into a coal-cutting machine at the Wellsgreen pit. His clothes caught in the picks and he was carried round the bar. The manager of the mine, Mr. Rowan, was cross-examined by Mr. Robertson, Inspector of Mines, and said that greater precautions were to be taken in future. The jury, in returning a formal verdict, stated that they were strongly of opinion that efficient means should be taken to provide for the greater safety of those working electrical coal-cutting machines.

Appointments Vacant.—General manager for the Oldham Corporation Tramways (£350); improvers in the power station and converter sub-stations of the Glasgow Corporation Tramways; shift engineer for the Eccles Corporation Electricity Works (30s.). See our advertisement pages to-day.

Inquiry.—Makers of the "Essex" accumulator are asked for.

Railway Disasters.—In the course of an editorial on railway risks, *apropos* of the accident near Hawes Junction, the *Times* yesterday made the following remarks:—

"The mischief wrought by fire is greatly increased if not actually introduced by the gas which is so largely carried for purposes of illumination. Gas light is cheaper than electric light, and thanks to the incandescent mantle the public is quite satisfied with the light which it affords; but the substitution of electric light for gas would greatly minimise the danger of fire, and would certainly limit its scope and the rapidity with which it spreads. The substitution of electric light for gas would entail considerable expense, but inasmuch as it would remove a principal cause rather than provide an uncertain expedient for dealing with an almost certain effect, the extra cost as compared with the provision of fire-extinguishers and tools would probably be well repaid."

Further:—

"A Blackburn correspondent telegraphs that important experiments are being conducted on the Lancashire and Yorkshire Co.'s railway system in East Lancashire, the object being to safeguard passengers and rolling stock in cases where vehicles are left on the lines by inadvertence. The metals have electric wires attached communicating with a signal cabin, and the uncoupling of coaches or light engines on the rails is automatically registered in the cabin, the notification remaining until the line is clear."

It will be seen that both these paragraphs are in full agreement with our leaderette on this subject, which went to press on Wednesday. If public opinion can be sufficiently aroused, there is no doubt that important reforms of this nature will be forcibly urged upon the railway authorities.

Electrical Engineers' Difficulties.—In the Lord Mayor's Court last week, before Assistant Judge Jackson, Messrs. H. G. Mayer & Co., electrical engineers, of Aldersgate Street, E.C., sought to enforce payment of a sum of £8 18s. 8d., balance of judgment debt and costs due from Mr. J. P. Naylor, electrical engineer, of 1, Gresham Street, E.C. The defendant appeared and said he was unable to comply with an order which had been made against him on December 16th in his absence, owing to his being in another Court. He was an electrical contractor, but had had one or two unfortunate losses in business from which he could not seem to recover. He had a number of orders in other Courts, and he ought to be paying a good many pounds a week. The Assistant Judge thought if the debtor had a great many creditors, the best thing for him to do was to call them together and make some proposition. The defendant said he had had 12 months' struggle, and he was not much better off now than when he started. The orders made against him amounted in the aggregate to about £6 a week, and he should be glad of some relief. The Assistant Judge thought it was unfair for one creditor to have a larger order for payment than another. The defendant said that a creditor who had an order for payment of £1 a month against him did not press him. For the plaintiffs it was said although the defendant had said his position had been a precarious one during the last 12 months, he had had the plaintiffs' goods and used them in his business and had not paid for them. The Assistant Judge said he quite agreed that the plaintiffs ought to have been paid. The defendant said he did not think he had had the goods from the plaintiffs within the last 12 months. The plaintiffs' report said that goods were had from the plaintiffs in April last. The defendant observed that he had been very careful during the past 12 months not to have much credit. He knew it was impossible to face another year in the condition of affairs. He would either call a meeting of his creditors or make some arrangement with them. The Assistant Judge said he would adjourn the case. He thought the plaintiffs should not bring the matter on again until the middle of January.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—The City staff and employés of the Charing Cross, West End and City Electric Supply Corporation have presented a silver English lever watch, suitably engraved, to MR. ARTHUR MAYRAL, late sub-station foreman, who has resigned to take up an appointment at Trinidad.

MR. J. B. PATTERSON has been appointed works superintendent at Lancaster, at a salary of £2 per week.

MR. ALFRED E. THOMAS, of Partick electricity department, Glasgow, has been appointed senior clerk to the electricity undertaking at Walthamstow.

The Southend-on-Sea T.C. has appointed MR. LUFF, of Southend, as canvasser, to obtain additional consumers of electricity on two days per week for a month, at 8s. 6d. per day.

The Electricity Committee of the York T.C. has appointed MR. G. M. PEARSON, of Fulham, as charge engineer at the electricity works, at a salary of 35s. per week, rising by £10 a year to a maximum of £110 per annum.

On Friday last the staff and employés of the Walsall Corporation Electricity Works presented MR. W. F. HUNT, engineer-in-charge, with a clock on the occasion of his wedding. The borough electrical engineer, Mr. A. S. Barnard, made the presentation.

General.—*Indian Engineering* says that the present staff of the Bengal-Nagpur Railway in the electrical department consists of the electrical engineer (Mr. E. S. Franklin) and one assistant (Mr. M. Walton). A second assistant electrical engineer, MR. DOUGLAS KERRIDGE, has now been appointed and sent out by the London Board of Directors.

NEW COMPANIES REGISTERED.

Montreal Tramways and Power Co., Ltd. (113,139).—This company was registered on December 9th, with a capital of £4,110,000 in 200,020 shares of £20 10s. 11d. each and one share of £422 8s. 4d., to construct, purchase, lease or otherwise acquire tramways and street railways in Canada or any Province thereof, or to acquire the shares, bonds, debentures or other securities of any company owning or controlling the same, to equip and maintain the same by electricity, steam, horse or other mechanical power, to carry on the business of tramway, railway, automobile, omnibus and van proprietors, carriers of passengers and goods, manufacturers of and dealers in carriages, trucks, locomotives, motors, accumulators, dynamos and the like, to enter into any contracts with other companies or persons as to interchange of traffic, running powers or otherwise, to supply electricity for light, heat, power or other purposes, and to adopt an agreement with the Imperial Trust Co. of Montreal. The subscribers (with one share each) are:—C. O'Malley, 4, St. Mary Axe, E.C., solicitor; G. O. Jones, B.A., 38, Liberia Road, Highbury, N.; L. Jones, 4, St. Mary Axe, E.C., solicitor; F. C. S. Squires, 21, Hereford Road, Wanstead, N.E., solicitor; A. Hurner, 3, Highbury Quadrant, N., student; W. H. Barnes, 60, High Street, South Norwood, S.E., clerk; G. J. Strachan, 246, Katherine Road, Forest Gate, E., clerk. Minimum cash subscription, 100 shares. The number of directors is not to be less than three or more than 15: the subscribers are to appoint the first. In all computations respecting the company's capital and affairs, £1 sterling is to be taken as equivalent to $4·86⅔, Canadian currency; qualification as fixed at statutory meeting; remuneration as fixed by the company. Registered office, 4, St. Mary Axe, E.C.

T. H. Brooker & Co., Ltd.—This company was registered on December 6th, with a capital of £5,000 in £1 shares, to carry on the business of electricians, mechanical engineers and manufacturers, workers of and dealers in electric or mechanical motive power and light, &c., and to adopt an agreement with H. Brooker, W. A. Hooper and F. A. Young. The subscribers (with one share each) are:—H. B. Tuffill, St. Michael's House, Cornhill, E.C., chartered accountant; H. Brooker, 10, Dane Street, Holborn, W.C., electrical engineer; W. A. Hooper, 10, Dane Street, Holborn, W.C., electrical engineer. Private company. The number of directors is not to be less than two or more than five; the first are H. Brooker, W. A. Hooper and H. B. Tuffill. Registered office, St. Michael's House, St. Michael's Alley, E.C.

Scientific Illumination, Ltd. (113,252).—This company has just been registered with a capital of £5,000 in £1 shares, to carry on the business of electricians, mechanical engineers, suppliers of electricity, &c., and to adopt an agreement between G. St. J. Wood, J. L. Hall and P. Smith. The subscribers (with one share each) are:—A. Smith, 19, Imperial Building, Exchange Street East, Liverpool, accountant; H. M. Mines, Ivy Cottage, Mount Pleasant Road, Liscard, cork merchant. Private company. The number of directors is not to be less than two or more than five; the first are G. St. J. Wood and J. L. Hall. Registered by Jordan & Sons, Ltd., 116-17, Chancery Lane, W.C.

Crystal Palace Kearney High-Speed Railway Syndicate, Ltd. (113,126).—This company was registered on December 8th, with a capital of £30,000 in £1 shares, to deal with a railway, tramway, rolling stock, approaches, stations, surroundings, locomotives, cars, carriages or other vehicles, and all accessories and appurtenances, wholly or partly in accordance with the Kearney high-speed system or otherwise in the grounds of the Crystal Palace, and to adopt an agreement with E. W. C. Kearney. The subscribers (with one share each) are:—H. G. Trew, 9, St. Helen's Place, E.C., chartered secretary; A. Taylor, 50, Sutton Road, Muswell, N., clerk; W. A. S. Andrew, 9, St. Helen's Place, E.C., registrar; F. Robertson, 9, St. Helen's Place, E.C., accountant; S. G. Head, 30, Claygate Road, West Ealing, clerk; H. W. Healy, Glenside, 4, Glebe Road, Barnes, S.W., electrical engineer; E. W. C. Kearney, 100, Victoria Street, Westminster, civil engineer. Minimum cash subscription, seven shares; the directors are to number not less than two or more than five; E. W. C. Kearney is the first; qualification, 100 shares; remuneration, £100 each per annum (chairman, £120). Registered office, 100, Victoria Street, S.W.

Gas Maintenance Co., Ltd. (113,075).—This company was registered on December 6th, with a capital of £5,000 in £1 shares, to carry on in Nottingham and elsewhere the business of a gas and electric light maintenance company, and to adopt an agreement with A. Docking. The subscribers (with one share each) are:—A. Docking, 13A, George Street, Nottingham, gas engineer; T. Callan, 27, Redcliffe Road, Nottingham, colliery agent; F. Stokes, 10, Premier Road, Nottingham, incorporated accountant; F. H. Guy, Elmhurst, Lucknow Drive, Nottingham, engineer; F. Barnes, Merchiston, All Saints Street, Nottingham, lace manufacturer. Private company. The number of directors is not to be more than five; the subscribers are to appoint the first; qualification, £100; F. Stokes is the first secretary. Registered by Jordan & Sons, Ltd., 116-17, Chancery Lane, W.C.

Garnbica Quarry and Lighting Co., Ltd. (113,259).—This company was registered on December 16th, with a capital of £1,000 in £1 shares (600 ordinary and 400 "B"), to carry on the business of winners and workers of and dealers in limestone, spar, marble, granite and other stone and minerals, ore, earths and mineral substances, electrical engineers, suppliers of light, heat, sound and power, &c. The subscribers (with one share each) are:—J. Fleming, 24, Miskin Street, Cardiff, coal inspector; W. Phillips, Hazelwood, Radyr, Glam., coal inspector. Private company. The subscribers are to appoint the first directors. Registered office, 57, James Street, Cardiff.

Crossley Motors, Ltd. (113,202).—This company was registered on December 13th, with a capital of £140,000 in £1 shares, to take over the business of motor manufacturers carried on as a branch of their general business by Crossley Bros., Ltd., and all or any part of the share capital of Charles Jarrott & Letts, Ltd. The subscribers (with one share each) are:—W. B. Hindle, 8, Great Queen Street, W.C., merchant; Sir Wm. J. Crossley, Bt, Glenfield, Altrincham; K. I. Crossley, Mobberley Hall, Knutsford, Ches., managing director of Crossley Bros., Ltd.; W. M. Letts, 45, Great Marlborough Street, W., governing director of Charles Jarrott & Letts, Ltd.; H. Penlock, Craigside, Mount Ararat Road, Richmond, secretary; C. H. Lamb, 104, Esmond Road, Bedford Park, W., engineer; W. C. Hammond, 34, Huntingdon Road, East Finchley, N., cashier. Minimum cash subscription, seven shares. The number of directors is not to be less than three or more than five; the first are Sir Wm. J. Crossley, Bt., K. I. Crossley and W. M. Letts (managing director); qualification of first directors, £1; of others, £500; remuneration (except managing director), £200 each per annum. Purchase consideration: £156,750 (£15,000 cash, £74,200 shares and £70,000 debenture stock, taken at price of 96½ per cent). Registered office, Napier Street, Gorton, Manchester.

Magnet Galvanising and Plating Co., Ltd. (113,210).—This company was registered on December 13th, with a capital of £30,000 in £1 shares, to carry on the business of electrical engineers, electricians, engineers, contractors, electrometallurgists, galvanisers, &c., and to adopt an agreement with S. O. Cowper-Coles, the Cowper-Coles Engineering Co., Ltd., and the Cowper-Coles Galvanising Syndicate, Ltd. The subscribers (with one share each) are:—E. Watson, 164, Henley Road, Ilford, secretary; C. J. Tonkin, The Hollies, Cleveland Road, South Woodford, clerk; H. V. May, The Lodge, Stockwell Orphanage, Clapham, S.W., clerk; A. S. Pearce, 25, Montpelier Place, Brompton Road, S.W., stenographer; E. A. Thomas, 47, Arngask Road, Catford, S.E., clerk; A. E. Cadby, 128, Clapham Road, S.W., secretary; G. H. Davies, 26, Blomfield Court, Maida Vale, W. Minimum cash subscription, £100; the numbers of directors is not to be less than three or more than five; the subscribers are to appoint the first; qualification, £200; remuneration, £50 each per annum and a percentage of the profits (total remuneration not to exceed £1,500 in any year). Registered office, 82, Victoria Street, S.W.

La Regionale Electrique de L'Orne, Ltd. (113,227).—This company was registered on December 14th, with a capital of £24,000 in £1 shares, to install and exploit works for distributing electric power in the department of the Orne and neighbourhood, France, and elsewhere. The subscribers (with one share each) are:—E. Vango, 8, White Horse Lane, Stepney, E., gentleman; F. C. Sanders, 93, Hibbert Road, Leyton, clerk; H. Bowden, 1, Broad Street Place, E.C., secretary; E. Hasler, 31, Prout Road, Clapton, N.E., gentleman; J. Fulton, 19, Common View, Letchworth, accountant; G. F. Aldridge, 24, Coleman Street, E.C., clerk; W. R. Sparshott, 22, Gladstone Road, Wimbledon. Minimum cash subscription £7. The number of directors is not to be less than two or more than five; the first are C. Ricoreau and Couture Taillat (both permanent); remuneration, £40 each per annum (chairman £60). Registered office, 1, Broad Street, Finsbury Circus, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Traction Supplies Co., Ltd.—Particulars of £1,000 debentures, created November 15th, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £600. Property charged: The company's undertaking and property, present and future. No trustees.

London Electric Treatment Institute, Ltd. (106,854).—Issue on December 1st of £100 debentures, part of a series of which particulars have already been filed.

Nottinghamshire and Derbyshire Tramways Development Co., Ltd. (75,577).—Issue on December 1st of £125 debentures, part of a series of which particulars have already been filed.

Ferabin Lamp and Electrical Accessories, Ltd. (106,073).—Debenture dated November 23rd, 1910, to secure £2,200 charged on the company's undertaking and property, present and future, including uncalled capital. Holder: G. E. Corfield, Balfour House, Finsbury Pavement, E.C.

English Electrical Co., Ltd. (112,639).—Particulars of £3,500 debentures, created November 19th, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's property, present and future, including uncalled capital. No trustees.

Cowans, Ltd. (57,378).—A memorandum of satisfaction to the extent of £900, on December 24th, of debentures dated May 4th, 1909, securing £3,000, has been filed. (Notified December 1st, 1910.)

Paignton Electric Light and Power Co., Ltd. (98,437).—Issue on November 29th of £1,600 debentures, part of a series of which particulars have already been filed.

Provincial Tramways Co., Ltd. (6,445).—Return dated December 2nd, filed December 7th, 1910. Capital £275,440, in 10,000 pref. shares of £10 each and 175,440 ordinary shares of £1 each; 10,000 pref. and 124,560 ordinary shares taken up; £162,700 paid; £61,860 considered as paid. Mortgages and charges: £175,000.

Manaos Tramways and Light Co., Ltd. (101,081).—Return dated December 7th, filed December 8th, 1910. Capital £300,000 in £1 shares. All shares taken up; £100 paid; £299,900 considered as paid. Mortgages and charges: £300,000.

Tewkesbury Electric Light Co., Ltd. (97,848).—Particulars of £1,500 debentures, created November 26th, 1910, filed pursuant to Sec. 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Madras Electric Supply Corporation, Ltd. (87,409).—Particulars of £200,000 debentures, created July 20th, 1910, filed pursuant to Sec. 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £100,000. Property charged: The company's undertaking and property, present and future. No trustees.

Railless Electric Traction Co., Ltd. (98,728).—Issue on December 7th of £750 debentures, part of a series of which particulars have already been filed.

Marconi's Wireless Telegraph Co., Ltd. (53,403).—A memorandum of satisfaction in full on December 1st, 1910, of mortgage dated September 30th, 1908, securing £1,465 15s., has been filed.

CITY NOTES.

Costa Rica Electric Light and Traction Co., Ltd.

THE directors report that for the year ended June 30th, 1910, the net earnings in Costa Rica, after charging all expenses incurred, amount to £14,530, as compared with £13,938 for the previous year. These figures do not represent the whole improvement in the company's trading profit, as the directors have deemed it advisable to write off various items in the shape of unpaid claims hitherto held in suspense. The volume of business exceeded that of the previous year by approximately £4,000. The renovation of cars has been continued and the cost charged to revenue account. The station plant was worked to its full capacity, so that no further expansion of business was possible, the increased revenue having been principally obtained from the Guadalupe tramway extension, which is practically a day load. It should be borne in mind that the earnings from this source are for 8½ months only of the year under review, the service having commenced on October 12th, 1909. Work on the new power development at El Brasil has continued throughout the year, and is still in progress. The greater portion of the installation has been completed. The power house is erected and the generating plant (three turbo-alternators of 600 KW. each) is in position. The pipe line (1,400 ft.) is nearly finished, and the aqueduct (1,000 ft.) almost ready. The tunnel (2,500 ft. in length and 10 ft. square) is pierced with the exception of 200 ft. The transmission line, with transformers, poles and fittings, has been delivered. The lining of the tunnel and the making of the weir are the only heavy items still remaining. The directors regret to say that owing to faults in the strata encountered in the tunnel, to the general softness of the rock, and to the difficulty in securing a safe abutment for the weir, these items will prove more costly than was anticipated. From inquiries received, the directors have reason to believe that a considerable business may be obtained for bulk supply when the work is completed. As far as can be foreseen this should be not later than July, 1911. Up to the end of June last £58,100 of the prior lien bonds have been issued for the tramway extension and the Brasil development, and a further £16,900 have since been taken up. The extra interest involved, and the writing off of the remainder of the Troyo suspense account referred to in the last report, explain the small amount carried forward. The company has sustained a great loss by the death of its esteemed and capable manager, Mr. Gilbert Holt Green, who died at San José, on October 6th last. For more than six years Mr. Green devoted all his energies and great abilities to the company's service, and the board feel sure that the shareholders will join with them in a sincere expression of condolence with his widow. So far the directors have not been able to decide on a suitable successor, and the management has been vested temporarily in the local director, Mr. Hemmann. During the year the gold premium has averaged 110 per cent., as against 115 per cent. for the previous year. The general manager certifies that all buildings, machinery, plant and permanent way, have been kept in good working order. The insurable buildings, machinery, and rolling stock are adequately covered against risk from fire.

Liverpool Electric Cable Co., Ltd.—At the general meeting held on 22nd inst., a final dividend of 15 per cent., making with the 5 per cent. interim dividend paid in June, a total of 20 per cent. for the year, was declared.

Continental.—FRANCE.—The report of the Compagnie d'Electricité de l'Ouest-Parisien (Ouest-Lumière), of Paris, for the last financial year shows a net profit of £47,054.

BELGIUM.—The balance-sheet of La Compagnie Internationale des Lampes Electriques (Zircone Wolfram, of Brussels, for the last financial year, shows a profit of £5,454.

Siemens & Halske.

The directors of this Berlin company, in reporting on the year 1909-10, state that the results were wholly satisfactory, the dividend being, as announced on December 9th, 12 per cent. on the ordinary share capital of £3,150,000, or the same rate as in 1908-9. The degree of employment in most manufacturing departments again increased, and the number of officials and workers was correspondingly augmented. A considerably greater activity had also taken place in the new year in many branches of the company's varied interests, and the necessity for large extensions of plant and equipment presented itself, particularly in the branch for heavy currents both at home and abroad. As a consequence of the further increased liquidity, the company was in a position to meet all requirements of that kind. A reserved attitude commended itself in forming an opinion as to the further development of the electrical industry and its internal conditions, and for that reason special regard had been paid to careful valuation in the preparation of the accounts. The Wernerwerk, Blockwerk and Wienerwerk were satisfactorily employed during the year, and yielded good results. Individual departments, which chiefly worked for Imperial and State authoriti s, suffered, however, from the continual depression. It was to be regretted that the undertakings worked by the Empire and State were frequently compelled, owing the general financial situation, to postpone installations whose productivity was settled. With reference to the recently opened branch of automatic telephone exchanges, the report stated that the first contracts had been carried out in the domain of the Bavarian, Austrian and Imperial Telegraph Administrations, and the exchanges had been set in operation with complete success. As a result of further improvements in the Pupin system, underground telephone cables up to a length of 620 miles could now be carried out with good transmission of speech, and thus the possibility was afforded of developing interurban telephony independently of the frequent interruptions through the effects of the weather, and from the influences of electric railways and high-pressure installations. A gutta-percha submarine cable on the Pupin system had been laid across the Channel by the firm of Siemens Brothers & Co., and had given excellent results. The manufacture and sale of tantalum lamps by the glow lamp factory had substantially increased, but prices had to give way owing to the pressure of competition. During the year a new metallic wire lamp—the first having a filament of drawn tungsten wire and representing the solution of an important problem that had long been sought for—was placed on the market, under the name of the Wotan lamp. The construction of elevated and underground railways in Berlin and neighbouring towns was making steady, although slow, progress. In Hamburg the circle line of the elevated electric railway was being completed as rapidly as possible; and the branch line to Eimsbuttel had been put in hand. The working equipment of the Hamburg railways was being carried out for the account of an operating company yet to be formed. The working of the Schoneberg underground railway was in the hands of the company for one year from December 1st, 1910, for the account of the town of that name, and it would then be transferred to the Berlin Elevated and Underground Electric Railway Co. In conclusion, the report of the company, which has a loan capital of £1,308,000, mentions that a further favourable development took place in the case of the Siemens-Schuckert works; that the Austrian Siemens-Schuckert Co. was able to raise its rate of dividend from 5 per cent. in 1908 to 6 per cent. in 1909, and the Russian Siemens & Halske Co. from 4 to 5 per cent., whilst Siemens Brothers & Co. maintained the rate of 4 per cent. in the past two years.

Siemens-Schuckert Werke.

The report of this company, whose financial results for 1909-10 were recently published in this column, states that the electrical industry had for a number of years experienced a constantly increasing demand. The orders received by the company during the year were again substantially greater than in the preceding 12 months, and the course of the early months in the new financial year also showed that the requirements were still growing. The gratifying results for 1909-10, which were represented by a dividend of 10 per cent., were due to systematic and continued progress in technical and organisation development and to increased manufacturing within the limits of a uniformly organised and connected mechanism. On the other hand, there could be no doubt that the relations between individual members of the German electrical industry exhibited a growing irregularity and over-tension, and mutual competition was becoming still keener. There were few branches in which the development of prices produced by competition did not often take place by leaps, incapable of any possibility of calculation The principal counterpoise to the effect of such injuries, in which all members of the trade were involved, had hitherto consisted in the constantly progressing development of requirements, which doubtless received an incentive from the falling tendency of prices. The problem was now placed before the electrical industry of being compelled to unite keen competition with a price arrangement upon a commercial and national economic basis, and in this way to reach a sound business practice. It was to be desired that the solution in some measure might be found before the present rising curve of requirements was succeeded by a period of stagnation or temporary retrogression, as it occurred in the course of every development. Nevertheless, the circumstances gave sufficient occasion for caution and foresight, and the company had taken them as a pattern in the preparation of the balance-sheet for 1909-10. The transfer of the machine works from Charlottenburg to the Nonnendamm, the report proceeded to state, was now to be followed by the removal of the apparatus factory to the same site, whilst the cable works were to be located in a new building to be erected on land acquired from the town of Spandau on the banks of the Berlin-Stettin ship canal. The shops thereby released at Charlottenburg would be devoted to the requisite extension of the manufacture of special products which could be made in a locally separate works. The Nuremberg works would also experience an extension that was necessary for the important part of the local manufacture. The mining and iron and steel trades had again afforded abundant opportunity for work, although the former still suffered from the after-effects of the past unfavourable times. Large orders were received for electrically-operated winding engines for collieries, potash mines, and South African mines. The centralisation of works departments, with the object of cheapening the cost of production and the utilisation of existing sources of power, made further progress; and in all other branches of industry business showed further development of a normal character. Extraordinary activity prevailed in the branch for overland central stations of an agricultural character, this being a sphere in which the electrical industry stood in keen competition with other industries, which not inconsiderably restricted the former. In the manufacture of high-pressure cables the report mentioned one in progress for a working pressure of 60,000 volts for the Bitterfeld-Dessau State railway. The great competition in turbine sets had so far depressed prices that often no profits were obtained. The tramway business was favourable during the year, and, in addition to new lines, orders for extensions and repeat orders were received on a large scale, whilst business in works and mining railways was very active. As to large main line railways in the past year, the contract for the Kiruna-Riksgränsen (Ofoten railway) line, which was 80 miles long, had been allocated by the Swedish Government to the combination formed by the company and the Swedish electrical industry. The deliveries effected in 1909-10 by the works in and outside of Germany amounted to 66,227 generators, motors and transformers of a total of 1,546,247 KW., as compared with 52,038 and 1,201,170 KW. respectively in 1908-9. It may be added that the company's share capital reaches £4,500,000, and the loan capital £969,000.

Elektrizitäts Gesellschaft vorm Schuckert.

The report of this Nuremberg company, which proposes, as recently reported, to pay a dividend of 7 per cent. on the ordinary share capital of £2,500,000 in 1909-10, as compared with 6 per cent. in the previous year, refers first to the adoption of a scheme of taxation reform by the Bavarian Diet, and states that consideration would have to be given to the question of measures whereby the increased taxation, amounting in future to about one-fifth of the annual net profits, could be reduced. During the year the company followed up a number of new transactions and participated in the erection of a number of overland stations in numerous places at home and abroad, partly direct and partly in agreement with its subsidiary companies, which afforded valuable points of support. These stations would presumably only develop slowly, but they could not well be neglected in view of the future prospects in connection with favourable conditions of the concessions. In accordance with its position in the south of Germany, the company had devoted itself in particular to the question of overland stations in Bavaria. Nevertheless, the activity in this direction had not hitherto had everywhere the same success as in Central and North Germany, as, owing to a too high estimation of Bavarian water powers, there had been a disposition to overestimate the productiveness of overland stations, and to seek to attach burdens to the establishment of the undertakings which the latter were unable to bear in comparatively thinly-populated districts of a rural character. The company had erected a central station for the supply of the town of Ansbach and neighbouring localities, which would shortly be set in operation, and a group had been formed in conjunction with the towns of Nuremberg and Furth, and their associated banks, which intended to supply both towns and other districts of Franconia. The accounts show central stations under the management of the company of the value of £129,000, whilst investments are returned at £1,873,000, but these do not include the share of £2,212,500 held in the Siemens-Schuckert Works. Apart from the ordinary share capital, the Nuremberg company has a loan debt which by drawings has been reduced by £70,000 in the past year to £1,925,000, whilst the mortgage debt remains at £63,000, as in 1908-9.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in :—

New Superheater Co., Ltd.—Further issue of 2,178 shares of 10s. each, fully paid (Nos. 80,877 to 83,054).

And to allow the following securities to be quoted in the Official List :—

Electric Light and Power Co. of Cochabamba—£300,000 6 per cent. Government guaranteed loan (bonds, Nos. 1 to 2,800 of £100; and Nos. 2,801 to 3,800 of £20 each).

Northern Light, Power and Coal Co., Ltd.—$600,800 additional 5 per cent. first mortgage 20-year gold bonds (Nos. 2,325 to 2,855 of $1,000, 1,118 to 1,150 of $500 and 668 to 700 of $100 each).

Melbourne Electric Supply Co., Ltd.

MR. J. BEVAN BRAITHWAITE, chairman, presided on 21st inst. at the offices, Finsbury Pavement House, London, E.C., over the eleventh annual meeting of the above company.

The CHAIRMAN, in moving the adoption of the report (see ELECTRICAL REVIEW, page 997) and accounts, said they could congratulate themselves on the extremely satisfactory progress made during the past year, which was reflected in all branches of the undertaking. In the first place, the new customers connected were a record for the company, there having been 908 new customers during the year. They had had an increase of 25 per cent. in the units sold, which was extremely satisfactory in view of the fact that they had had to meet the full brunt of the reduction in current caused by the almost universal adoption of the metallic-filament lamp. It would not have been surprising if this had counter-balanced the current consumed by the new customers, but as it had turned out, their sales were 628,000 units in excess of the previous year, which was almost exactly 25 per cent. increase. Then they had extended their mains into 32½ miles of additional streets, so that they now supplied 132½ miles of streets in Melbourne. They had had some very good additions to their power connections, which showed an increase equivalent to 20,000 16-C.P. lamps, and their lighting connections an increase equivalent to 14,811 16-C.P. lamps. From these points of view, the record was a satisfactory one, showing new customers, 908, against 370; units, 25 per cent. up; power connections, good; and, in spite of the metallic-filament lamp, an increase of revenue of £7,000. Of equal importance was the fact that they had obtained an Order in Council for the supply to Brighton and also for the supply to Camberwell and were negotiating for the transfer of the Hawthorn Order to them, and, by arrangement with the local authority, were now doing a small amount of lighting there. So, it would be seen, they had made a considerable addition to the area of supply, and these were areas which were likely to give a good return in the future. A further gratifying feature of the year was that they had commenced the supply of power for tramway purposes. They had been supplying power to the Prahan Malvern Tramways for some few months, and so satisfactory had these tramways turned out to be, that the local authorities concerned were asking them to double their supply, and, as a matter of fact, plant was on order for that purpose and would be shipped very shortly, so that, in the current year, they could look for an increasing revenue from that source. In Geelong they had moved more slowly, but, at the same time, progress was being made. Their connections had increased by about 12½ per cent., and they were now engaged in the construction of tramways which should be ready for traffic in the course of the current financial year. The route would be about 1½ miles, and the tramways would give a day-load to the station, which was always a good thing. He hoped that the fact of having electric tramways in Geelong would tend to wake up that somewhat sleepy place, and lead it to be more enterprising all round, in which case, no doubt, they would get an increased demand for current. Therefore, he thought things were more encouraging than they had been at any time since the beginning of the company. Turning to the accounts, they would not find the state of things he had described so clearly reflected therein. The capital expenditure in Melbourne during the year had been £49,000, and that had been provided partly by the sale of some of their Adelaide shares, and partly in other ways. There was no actual change in the capital account, which stood at £274,170 preference and ordinary shares, and £252,083 debentures. On the other side, the expenditure was now at Melbourne £364,731, against £321,163 last year, and at Geelong £64,242, against £57,903. Turning to the profit and loss account, the profit on the Melbourne undertaking was £19,279, as compared with £20,573; which, at first sight, looked a little discouraging with an increase of 25 per cent. in the units sold. There were two things, however, which fully explained the decreased profit. In the first place, they had an unfortunate coal strike in the early part of the year, which cost them a considerable amount, and secondly, they had re-engined one of their old generators at a cost of £2,000, and had debited this against revenue, because they regarded it as a renewal in a certain sense. They might easily have put this £2,000 in some other form, and so shown rather more profit to the Melbourne undertaking, in spite of the coal strike; but he thought they would agree that the course adopted was a sound one. The result would be considerably increased economy during the coming financial year, because it was a set which took a great deal of the light load. The total result was that they had a balance of £13,674 to transfer on the Melbourne account, as against £13,469 last year. The reason they were able to carry a little more into the balance-sheet, notwithstanding that the profit was less, was because some items of legal expenses, guarantee on loans, and loss on the sale of Adelaide shares, which had to be dealt with in the previous year's accounts, did not recur last year. They proposed to transfer a further £5,000 to the depreciation and general reserve, which would bring that up to £17,000; to credit the profit on the Adelaide shares in reduction of the suspense account, and also to write down that account by another £1,966. This would leave the suspense account at £6,000, and following the policy of applying £3,000 a year to this account, it meant that in two years it would be wiped out, and the £3,000 would then be available for dividend or other purposes. If their recommendations were adopted it would leave £3,351 to be carried forward to the new year. The progress which had been made during the first two months of the current year was phenomenally good, although he could not say that it was going to be maintained. Last year the number of new customers connected per month averaged 75, but this year they connected 228 new customers in September and 251 in October, or a total of 479 in two months. This increase, combined with the increased tramway load they expected, led them to hope that the financial result for the current year would show a considerable improvement. During the year they had had the advantage of having Mr. F. W. Clements, their engineer, over in this country, and they had discussed many matters. The company was much indebted to its staff, for without a loyal and dependable staff it would be impossible to carry on a business of this sort 12,000 miles away.

MR. R. PERCY SELLON, in seconding the motion, remarked that in the early years they had had to struggle with difficulties incidental to electrical enterprises all over the world, and in Australia they had had difficulties of their own to grapple with. He thought the time had now come when they could consider that they had emerged into a period of increasing prosperity.

MR. NICHOLSON called attention to the fact that the diagram in the report showed a profit in Melbourne of £48,000, whereas the accounts only showed £44,000.

The CHAIRMAN explained that the diagram included the figures for wiring, &c., which were separated in the accounts.

Another SHAREHOLDER pointed out that the diagram showed more profit than last year.

The CHAIRMAN said that was quite correct. More profit was made, but the board in London debited the £2,000 for the new engines against the profit.

The report was then adopted, and the retiring directors and auditors were re-elected; and, on the motion of the CHAIRMAN, a hearty vote of thanks was passed to the staff.

Previous to the annual meeting extraordinary meetings of the preference and ordinary shareholders were held under the chairmanship of Mr. Braithwaite. At the preference shareholders' meeting the following resolution was carried:—

(1) That the holders of the 6 per cent. cumulative preference stock of the company hereby consent to and agree to accept in full satisfaction of all arrears of cumulative dividend upon such preference stock, income bonds to be issued by the company at the rate of £1 for each £5 of stock held by them respectively; such income bonds to carry interest at the rate of 3 per cent. (non-cumulative), and to be payable both as regards principal and interest solely out of the profits of the company available for dividend after payment of dividend on the first preference shares and sinking fund on the debenture stock of the company, and to be amortised by the balance of a "service fund" of £1,800 (non-cumulative), remaining after payment of the above 3 per cent. interest on outstanding bonds. The said income bonds to be in such form and subject to such conditions as the directors may determine, and to be redeemed by purchase, by tender, and or by drawings as may be determined by the directors from time to time. (2) That as from September 1st, 1910, the whole of the said 6 per cent. cumulative preference stock shall be and shall be deemed to have been non-cumulative. (3) That as from September 1st, 1910, the whole of the said preference stock and 4,834 ordinary shares of the company already issued and fully paid be converted and consolidated into ordinary stock to be called "consolidated ordinary stock."

The resolution carried at the meeting of the ordinary shareholders expressed their concurrence in the above resolutions.

New Gutta-Percha Co., Ltd., and Reduced.—A petition presented for confirming the reduction of the capital from £200,000 to £125,000 will be heard in London on January 14th.

STOCKS AND SHARES.

Wednesday Morning.

WITH markets still in semi-holiday mood, there is not much to be gained by going over the various electrical departments and noting the small changes which have occurred in each. More interesting is it to revert to the usual practice of "stock-taking" as regards quotations, and we accordingly present lists of representative stocks and shares, showing the net movements on the year.

The past 12 months have been good ones for Stock Exchange business as a whole, but the excellence of the first half stands out in striking contrast to the quietude of the second. Electrical Railway stocks might complain that they have had no fair chance, because, except in Districts, the activity has been very backward. City and South London Ordinary is flat as a result of the year's work, and a short table illustrates what few changes there are apart from the two stocks mentioned.

Stock.	Dec. 28, 1909.	Dec. 28, 1910.	Rise or fall.
Central London Ord.	64	64	—
,, Pref.	86	86	—
,, Def.	46	45	— 1
City & South London	32⅛	26⅛	— 6
Great Northern & City	4	4¾	+ ¾
Metropolitan	40	39¾	— ¼
Metropolitan District	18½	27	+ 8½
,, ,, 6 per cent. Deb.	144	144	—

In coming to the shares of the London lighting companies, the lamentable upshot of the year is a large preponderance of falls, due to a variety of reasons amply discussed here from time to time. City of London shares are the only ones which have made any headway, but a rise of 15s. in Urban Preference deserves to be noticed.

The next batch of dividends and reports will be watched with eager interest, with a view to obtaining some clue as to whether the metal-filament lamp has spent its force for evil, and can now be regarded as a profitable servant. We append the comparative tables:—

Ordinary shares.	Dec. 28, 1909.	Dec. 28, 1910.	Rise or fall.
Brompton and Kensington	7½	7½	— ⅜
Charing Cross and Strand	4½	3½	— 1
Chelsea	3⅜	3⅜	—
City of London	10¼	11¼	+ ⅜
County of London	7⅜	7⅜	— ⅛
Kensington and Knightsbridge	7⅞	6¾	—
London Electric	1⅛	1⅛	—
Metropolitan	4⅛	3¾	—
Notting Hill	12⅜	12	—
St. James' and Pall Mall	8⅛	7½	— 1
Smithfield	1⅜	1⅜	—
South London	2⅛	2⅛	— ⅛
Urban Pref.	1⅜	2⅛	+ ⅜
Westminster	8⅛	7½	— 1⅝

One of the most interesting events of the year in the electricity supply world has been the increased activity of the Publicity Committee.

Taking a mixed group of manufacturing companies, the changes on the year display irregularity, but on balance are in favour of holders. The recovery in British Westinghouse 4 per cent. Debenture is one feature. Another is a good rise in Telegraph Constructions, and a third is the advance in Babcock & Wilcox, both due to good trade. A summary of the companies gives these quotations :—

Stock or share.	Dec. 28, 1909.	Dec. 28, 1910.	Rise or fall.
Babcock & Wilcox	4⅝	5⅜	+ 1⅛
British Insulated	6 1/16	7	+ 15/16
British Westinghouse Preference	⅜	⅜	— 1/16
Do. do. 4 per cent.	50 7/16	60⅝	+ 10 1/16
Callender's Ordinary	10⅜	9⅜	— 1
Castner-Kellner	2 5/16	3⅛	+ ⅞
Dick-Kerr	1 3/16	1 1/16	— ⅛
Edison & Swan "A" fully	1¼	1¼	—
General Electric Preference	8	8⅛	+ ⅛
Henley's Ordinary	12½	12⅝	+ ⅛
India-Rubber	15⅝	16⅝	+ 1
Telegraph Construction	34	38½	+ 4½
Willans & Robinson	¼	¼	—
Do. Preference	1⅛	1¼	— ⅛

The Telegraph market has done well during 1910, and its substantial yields from well-established concerns are continuing to attract much attention from the investor. As usual, there has been a lot of speculation in Anglo "A," and the bulls have just lately had the details of a provisional agreement between the Anglo and the Western Union Companies to confirm their expectations. Consequently, Anglo "A" shows the biggest rise in the following representative catalogue of Telegraph stocks and shares :—

Stock or share.	Dec. 28, 1909.	Dec. 28, 1910.	Rise or fall.
Amazon	35⅛	57⅛	+ 21⅛
Anglo-American Deferred	22	29	+ 7
Cuba	8⅜	8⅞	+ ⅛
Direct Spanish	3¼	3⅜	+ ⅛
Direct U.S.	13¼	15⅞	+ 2⅝
Eastern	135½	136½	+ 1
Eastern Extension	12	13	+ 1
Great Northern	30	31½	+ 1½
Globe Telegraph and Trust	10½	10½	—
Indo-European	52	54	+ 2
Mackay Common	94	93	— 1
do. Pref.	79	77	— 2
Marconi	5/16	5/32	+ 5/32
Western	13⅜	13⅜	—
West India and Panama	⅝	1⅜	+ 11/16
do. First Pref.	9	9⅛	+ ⅛
do. Second Pref.	8½	9	+ ½

After these there follow, of course, the telephone issues, where movements are mostly in the right direction, although of no great amount. A gain of 4½ points is not much for National Telephone Deferred, but throughout the year the bursts of activity in these securities have been extremely spasmodic. It is to be noticed, by the way, in the preceding list, that Marconi shares have had a fair rise, thanks largely to the advertisement which the system received through being the instrument that helped to hang "Dr." Crippen. This is a table of telephone prices :—

Stock or share.	Dec. 28, 1909.	Dec 28, 1910.	Rise or fall.
American Telephone and Telegraph	145	147	+ 2
Chili	7 1/16	7⅛	— 1/16
Monte Video	1/16	1/16	+ 1/16
National Preferred	107½	106½	— 1
" Deferred	124	128½	+ 4½
Oriental	1 7/16	1½	+ 1/16
United River Plate	7⅞	7⅞	+ ⅛

The animation in Latin-Canadian tramway, power and lighting companies' shares and bonds has proved one of the main features of the year. Out of the prices the rise in Mexican Light and Power Common shares stands as the principal movement, although Mexico Trams, with which company the power concern is practically amalgamated, are lower by a very small fraction. The figures shall speak for themselves :—

Stock or share.	Dec. 28, 1909.	Dec. 28, 1910.	Rise or fall.
British Columbia Electric Rly. Def.	143	148	+ 5
" " " Pref.	123	125	+ 2
British Electric Traction	¾	1	+ ¼
" " " Pref.	2⅛	3/16	+ 1/16
Canadian General	114½	105½	— 9
Calcutta Trams	4¼	4¼	—
Cape Trams	1/16	1/16	+ 1/16
London United Pref.	2¼	1⅞	— 3/16
" " Deb.	61½	69	+ 7½
Mexico Trams	124	123½	— ½
Mexican Light and Power	69	89½	+ 20½
Rio Trams	92	104½	+ 12½
Sao Paulo	154	153½	— ½
Shawinigan Water	104	109½	+ 5½

The outlook for the ensuing year is not at all bad, and with a relaxation of money rates in the new year, all investment stocks should tend to improve.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Route miles open.	Inc.
Aberdeen	Dec. 21	2,496	+ 130	29	41,988	+ 706	..	..
Ayr	" 24	377	+ 26	32	10,708	+ 400	8	..
Bath	" 24	1,371	+ 82	51	41,075	+ 2,140	..	..
Belfast	" 23	9,904	+ 779	38	156,54	+ 9,954	37	..
†Birkenhead	" 18	1,090	+ 68	37	41,286	+ 1,036	13·68	..
Birmingham Corp.	" 17	14,723	+ 917	37	254,777	+ 5,855	56·79	..
Blackburn	" 21	1,995	+ 133	38⅞	41,387	— 1,156	14·25	..
Blackpool Corp.	" 22	742	+ 119	..	50,866	+ 469	..	..
Blackpool-Fleetw'd	" 10	436	— 14	28	22,948	+ 633	..	..
Bolton	" 25	4,907	+ 695	39	91,716	+ 1,254	26	..
Bournemouth	" 21	2,787	+ 163	37⅜	69,858	+ 5,834	21·95	..
Bradford	" 17	9,633	+ 657	38	191,282	+ 7,913	54·8	..
Brighton	" 25	1,706	+ 168	38⅜	38,869	+ 468	9·5	..
Bristol	" 23	12,222	+ 792	..	..	..	..	..
Brit. Elec. Trac. Co.								
Airdrie	" 16	430	+ 21	50	10,963	+ 82	3·65	..
Barnsley	" 16	342	+ 28	50	8,626	+ 215	..	..
Barrow	" 16	444	+ 41	50	13,181	+ 1,652	5·37	..
Cavehill	" 16	110	+ 11	50	4,436	+ 246	..	..
Devonport	" 16	887	+ 199	50	21,397	+ 3,115	8·85	..
Gateshead	" 16	2,005	+ 38	50	49,659	— 27	11·25	..
Gravesend	" 16	295	+ 12	50	10,357	— 139	6·5	..
Greenock	" 16	923	— 32	50	30,365	— 139	7·25	..
Hartlepool	" 16	382	— 40	50	12,211	+ 478	6·72	..
Kidderminster	" 16	191	+ 18	50	5,806	+ 164	..	..
‡Leamington	" 16	273	+ 8	50	8,423	— 346	..	..
Merthyr	" 16	182	+ 12	50	10,296	— 124	2·9	..
Metropolitan	" 16	14,849	+2,931	50	374,718	+63,677	22	..
Middleton	" 16	569	+ 41	50	15,715	— 795	8·5	..
Mid. Joint Com'tee	" 16	11,818	+ 615	50	211,251	+ 4,798	..	..
Oldham—Ashton	" 16	1,071	+ 67	50	27,738	— 152	9·13	..
Peterborough	" 16	217	+ 26	50	5,807	— 64	5·31	..
Potteries	" 16	4,066	+ 295	50	90,153	— 95	29	..
Rothesay	" 16	82	+ 9	50	10,072	+ 177	2·75	..
Southport	" 16	465	+ 42	50	14,539	+ 356	8·17	..
S. Metropolitan	" 16	2,137	+ 260	50	54,251	+ 5,445	..	..
Swansea	" 2	1,959	+ 10	48	52,114	+ 5,185	12·5	..
Tynemouth	" 16	292	+ 27	50	12,477	+ 562	5·75	..
Weston-s-Mare	" 16	60	+ 4	50	7,140	— 21	3	..
‡Worcester	" 16	558	+ 57	50	14,164	+ 816	5·75	..
Wrexham	" 16	185	+ 18	50	4,851	— 86	..	..
Yorks. Wool. Dist.	" 16	1,912	+ 162	50	49,469	+ 3,429	17	..
Miscellaneous	" 2	333	— 30	48	10,227	+ 118	..	..
Burnley	" 24	2,559	+ 321	..	..	..	11·73	1
Burton-on-Trent	" 25	587	+ 71	38	10,608	+ 313	6·64	..
†Bury	" 18	1,108	+ 211	37⅞	44,199	+ 829	22·5	..
†Cardiff	" 17	2,195	+ 157	38	85,008	+ 1,442	..	..
Carlisle	..	..	..	..	..	..	..	..
†Chatham and Dist.	" 1	1,412	+ 5	48	40,956	+ 1,425	14·98	..
Cork	" 22	950	+ 55	51	24,820	+ 1,896	9·89	..
†Croydon	" 9	1,548	+ 39	..	60,944	+ 3,272	11·25	..
Darlington	" 17	396	+ 47	38	7,642	+ 632	..	..
Darwen	" 23	489	+ 29	38	9,538	— 37	4·36	..
Dover	" 17	354	+ 40	37	8,474	+ 376	4·75	..
†Dublin	" 16	5,342	+ 388	..	186,595	+ 3,111	54·28	..
Dundee	" 21	2,319	+ 107	31⅜	37,592	+ 708	15	..
†East Ham	" 17	1,066	+ 124	37⅞	18,989	+ 1,708	7·87	..
Exeter	" 23	591	+ 26	38	12,448	— 561	5·5	..
Glasgow	" 24	36,362	+3,258	..	529,242	+21,562	97·75	3
†Hastings	" 15	699	+ 59	..	..	..	..	..
†Huddersfield	" 3	1,727	+ 114	36	62,823	+ 3,468	28·5	..
Hull	" 24	5,975	+ 467	38	105,812	+ 5,550	14·5	..
Ilkeston	" 17	245	+ 13	38	4,9 3	— 218	..	..
†Ipswich	" 17	398	+ 58	37	16,163	+ 193	10·5	..
Kilmarnock	" 24	295	+ 29	32	4,892	+ 219	4·25	..
Lancashire United	" 21	2,453	+ 255	51	66,209	— 104	39	..
Leeds	" 17	18,730	+ 822	37	268,752	+ 8,614	57	..
Leicester	..	..	..	..	..	..	..	..
†Leith	" 17	521	+ 20	30⅜	18,916	+ 95	8·7	..
Liverpool	" 17	22,718	+1,197	50⅜	556,757	+18,823	116	6·5
‡L.C.C.	" 14	83,648	+7,349	..	1,501,930	+131,118	184·2	8·25
London United	" 24	11,689	+ 913	..	318,769	+12,683	..	..
Lowestoft	..	..	..	..	..	..	..	..
†Manchester	" 17	15,891	+1,236	37	576,630	+17,467	183	1
†Newcastle	" 17	3,941	+ 56	37	147,342	+ 1,725	14·5	..
Newport	" 17	1,342	+ 127	38	25,479	+ 916	14·5	..
†Oldham	" 18	1,801	+ 208	38	70,633	+ 528	28·5	·5
Pontypridd	..	..	..	..	..	..	..	..
†Portsmouth	" 17	1,795	+ 223	37	78,486	— 1,327	15·25	..
Preston	" 21	1,412	+ 136	38	27,896	— 147	..	..
Rotherham	..	..	..	..	..	..	..	..
†Salford	" 19	4,689	+ 495	37⅛	176,156	+ 4,496	..	..
†Sheffield	" 18	6,308	+ 714	..	236,419	+14,212	40	..
†Southampton	" 14	1,076	+ 145	37	41,081	+ 1,187	..	..
Southend-on-Sea	" 21	820	+ 105	38	23,294	+ 2,599	..	..
South Shields	" 24	1,067	+ 6	38⅜	21,635	— 110	..	..
Swindon	" 21	303	+ 48	..	5,501	+ 259	..	..
Tyneside	" 21	679	— 84	25	10,633	— 71	..	..
Wallasey	..	..	..	..	..	..	..	..
†Walthamstow	" 17	642	+ 75	37	26,754	+ 1,928	9	..
West Ham	" 15	5,031	+ 481	37	92,009	+ 4,818	15·25	..
Wolverhampton	" 21	1,985	+ 181	38	37,581	+ 3,862	14·25	..
Cen. London Rly.	" 24	11,888	+ 20	25	187,128	+ 3,336	6·32	..
City & S. Lon. Rly.	" 25	7 308	+ 480	25	80,735	+ 1,094	7·26	..
Dublin-Lucan Rly.	" 23	237	+ 11	25	3,733	+ 176	7	..
†G.N. and City Rly.	" 24	1,558	+ 62	25	35,915	+ 1,046	3·5	..
†L'pool Overh'd Rly.	" 18	1,380	+ 153	..	..	..	6·8	4·2
Llandudno-Col. Bay	..	..	..	..	..	..	..	..
London Elec. Ry. Co.	" 24	28 865	+1,785	25	315,465	+ 5,290	21·25	..
Mersey Railway	" 24	4 690	+ 313	25	50,424	+ 929	4·5	..
Metropolitan Rly.	" 25	38,069	+1,419	..	422,595	+13,321	24·5	..
Met. District Rly.	" 24	22,643	+1,988	25	268,746	+17,307	24	..
Anglo-Argentine	" 23	99,272	+12,018	..	..	..	..	..
§Auckland	Dec.	16,171	+1,241	..	91,989	+ 9,683	23·3	1
Bombay (B.E.T.)	Nov. 25	6.969	+ 53	47	129,442	+ 9,572	..	..
§Brisbane	Nov.	18,790	+ 2,560	44	200,420	+20,428	..	..
§Brit. Columbia Rly.	..	..	..	..	..	..	..	..
Calcutta	Dec. 24	7,087	— 24	..	..	..	..	..
§Cape Electric T.Ld.	..	..	..	..	..	..	..	..
§Kalgoorlie, W.A.	Nov.	3,335	..	..	89,087	..	20·5	..
Madras	Dec. 15	1,435	+ 30	..	31,121	+ 58	..	..
§Montevideo	Nov.	24,086	+2,196	..	..	..	..	..
§Lisbon	..	..	..	..	..	..	..	..
†Perth (W.A.)	Dec. 16	1,580	+ 15	..	68,988	— 6,142	29	1

* Compared with the corresponding period of 1909. † One week only.
‡ Includes horse, steam and other receipts. § One month.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1907.	1908.	1909.	Closing Quotations Dec. 20th.	Closing Quotations Dec. 27th.	Business done week ended Dec. 27th, 1910. Highest	Lowest.	Rise + or Fall —	Present Yield per cent
		*										£ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	5⅜— 6⅝	5⅜— 6⅝	..	..	..	Nil.
286,500	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	97 — 99	98½—100½	99	98½	+1½	4 19 6
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	8 %	145 —147	146 —148	..	..	+1	5 8 1
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
558,460	Anglo-American Telegraph	Stock	3½%	3½%	£3 4s.	3½%	69 — 71	70½— 72½	70	69⅝	+1½	5 0 0
3,220,770	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	112 —114	114 —116	115½	113½	+2	5 3 5
3,220,770	Do. do. do. Deferred	Stock	1¾%	1 %	8/-	25/-	28½— 28¾	28⅝— 29½	29⅛	28⅛	+ ⅛	4 5 6
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	102½	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	7 — 7¼	7 — 7¼	7¼	..	..	5 10 4
2,449,176	Commercial Cable, Sting. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	86	85	..	4 12 0
16,000	Cuba Telegraph	10	5 %	6 %	6 %	6 %	8½— 9½	8⅜— 9⅜	..	..	- ⅛	6 11 6
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	16⅜— 17½	16⅜— 17½	..	..	+ ⅛	5 16 9
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜— 3¾	3⅜— 3¾	..	..	..	5 1 7
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8¼— 8⅝	8⅛— 8⅝	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	101½—103½	101½—103½	..	..	..	4 7 0
60,710	Direct United States Cable	20	4½%	4½%	4½%	4 %	15⅜— 15⅝	15⅜— 16⅛	15⅝	15⅜	..	5 1 7
	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..	4 7 5
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	135 —138	135 —138	..	..	..	5 1 5
2,000,000	Do. 3½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	83 — 85	83 — 85	84⅛	..	..	4 2 4
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	99½—101½	99½—101½	..	..	..	3 18 10
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅝— 13¼	12⅝— 13¼	13⅝	13⅛	..	5 7 8
752,400	Do. 4 % Deb. Stock..	Stock	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
200,000‡	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99½—101½	99½—101½	..	..	..	3 18 10
181,127	Globe Telegraph and Trust	10	5½%	5¾%	5⅝%	5¾%	10⅜— 10⅝ xd	10⅛— 10⅜	10⅛	..	..	5 9 5
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13⅛— 13⅜ xd	13¼— 13⅝	..	..	— ⅛	4 8 1
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	20 %	20 %	18 %	18 %	30¾— 31½	31 — 32	..	..	+ ¼	5 12 6
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	53 — 55	53 — 55	..	..	..	5 18 7
$41,380,400	Mackay Companies Common	$100	3½%	4 %	4 %	4½%	92 — 94 xd	92 — 94	..	..	..	4 9 6
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	76 — 78 xd	76 — 78	..	..	..	5 0 0
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	⅜— ¾	⅜— ¾	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	6 %	¾— 1	¾— 1	..	..	..	6 0 0
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	25/32— 27/32	25/32— 27/32	..	..	..	5 11 1
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 —107	106 —107	106⅞	106½	..	5 12 2
3,725,000	Do. do. Def. Stock	100	5 %	6 %	6 %	6 %	127 —129	127½—129½	129	128¼	— ½	4 12 8
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10⅛— 10⅜	10⅛— 10⅜	..	..	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	5 %	6 %	6 %	6 %	10⅛— 10⅜	10⅛— 10⅜	..	..	..	5 10 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛— 5⅛	5⅛— 5⅛	..	..	..	4 10 0
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99 —101	99 —101	..	..	..	3 9 4
1,983,598	Do. do. 4 % Deb. Stock Red.. ..	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	7 %	8 %	8 %	8 %	1⅜— 1½	1⅜— 1½	..	..	..	4 14 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1⅜— 1⅝	1⅜— 1⅝	..	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	88½— 90½	88½— 90½	..	..	..	4 8 5
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 7
11,839	Reuter's	8	5 %	5 %	5 %	5 %	7½— 8	7½— 8	..	..	..	5 0 0
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 9 7
3,042	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	6 %	132 —135	132 —135	..	..	..	4 8 11
120,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	7½— 7¾	7½— 7¾	7⅞	7¾	..	5 6 8
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¼— 5½	5⅜— 5⅝	..	..	..	4 6 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	2½%	1⅞— 1 7/16	1⅞— 1 7/16	..	..	..	4 12 8
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	7 %	13½— 14 xd	13½— 14	13⅜	..	..	4 17 5
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —103	101 —103	100½	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	1⅝— 1 7/16	1 11/16— 1 13/16	28/6	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	8 %	6 %	6 %	6 %	9⅜— 9⅝	9⅜— 10	9 13/16	9⅜	+ ⅛	6 0 0
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	£2 6	15 %	14½%	8¾— 9¼	8¾— 9¼	..	..	..	6 9 9
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	..	5 %	4 13/16— 5 1/16	4 13/16— 5 1/16	100/-	98/1½	..	4 18 9
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	..	5 %	4 7/16— 4 11/16	4 7/16— 4 15/16	..	..	..	5 9 7
4,465,674	Do. 4 % Deb. Stock	Stock	..	..	4 %	4 %	92 — 93½	92 — 93½	93½	92⅞	..	4 5 7
332,387	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	103½—105½	101 —101	..	..	..	4 14 9
880,000	Babcock & Wilcox, 1 to 530,000	1	20 %	20 %	20 %	24 %	5⅜— 5⅝	5⅜— 5⅝	5 5/16	..	..	4 2 7
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅜— 1½	1⅜— 1½	..	..	..	4 0 0
1,000,000	British Aluminium 5 % Mort. Debs. Red.	100	..	..	..	..	..	..	..	..	..	5 9 7
500,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	8 %	8 %	8 %	146 —150	146 —150	..	..	..	5 6 8
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	6 %	6 %	123 —127	123 —127	..	..	..	4 14 6
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	110½—113½	110½—113½	111¾	..	..	4 8 1
338,000	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
133,301	British Electric Traction	10	Nil	Nil	Nil	Nil	⅞— 1⅛	⅞— 1⅛	..	..	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	3 %	1½%	Nil	3¼— 3 1/16	3⅛— 3 3/16	75/-	70/-	..	Nil
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	89 — 93	89 — 93	90	..	..	5 7
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	74 — 79	74 — 79	..	..	..	5 12 6
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	10 %	6⅞— 7¼	6⅞— 7¼	..	..	..	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6	5⅝— 6	..	..	..	5 0 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red..	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
201,579‡	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	Nil	¼— ½	¼— ½	..	..	..	Nil
1,316,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	59 — 62	59 — 62	..	..	..	6 9 1
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	9/16— 11/16	9/16— 11/16	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.. ..	2	Nil	Nil	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	37 — 42	37 — 42	..	..	..	10 14 4
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	23 — 27	23 — 27	..	..	..	18 19 3
137,610	Calcutta Trams, 1 to 137,610	5	8 %	6 %	4½%	4½%	4½— 5	4½— 5	..	..	..	4 10 0
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	5 %	5 %	5 %	5 %	4⅝— 5⅛	4⅝— 5⅛	..	..	..	4 17 7
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
35,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	10 %	9⅜— 9⅝	9⅛— 9⅜	9⅛	..	..	5 8 3
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4 13/16— 5 1/16 xd	4 13/16— 5 1/16	..	..	..	4 18 9
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	104 —106 xd	102 —104	..	..	—2	4 6 7
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	Nil	15/16— 1 1/16	15/16— 1 1/16	10 7/8	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	8 %	12 %	12½%	17½%	3 — 3¼	3 — 3¼	60/6	..	..	5 8 2
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4 %	4½%	105 —108	105 —108	..	..	..	4 3 4
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	3 %	3½%	3 %	63 — 65	63 — 65	64½	63½	..	4 12 4
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 12 0
554,655	Do. do. Def. do.	Stock	4 %	2 %	2½%	2 %	44 — 46	44 — 46	..	..	..	4 7 0
1,480,000	City and South London Railway	Stock	2½%	2½%	1½%	1⅝%	26 — 27	26 — 27	26⅞	26⅝	..	6 9 8
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	5 %	Nil	Nil	½— ¾	½— ¾	..	..	..	Nil
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	5 %	83 — 86	83 — 86	..	..	..	5 17 8

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Dec. 20th.	Closing Quotations Dec. 27th.	Business done week ended Dec. 27th, 1910.		Rise + or Fall —	Present Yield per cent.
		*	1906.	1907.	1908.	1909.			Highest	Lowest		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	6 %	5 %	⅞ — 1	⅞ — 1	..	..	..	5 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..	5 7 10
271,090	Do. do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	98 —101	98 —101	..	..	..	4 9 1
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	4½ %	2½ %	Nil	Nil	0 — ¼	0 — ¼	..	..	..	Nil
17,139	Do. "A" shares, 01—017,139	5	4½ %	2 %	Nil	Nil	1 — 1½	1 — 1½	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	63 — 68	63 — 68	..	..	..	5 17 8
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	77 — 80	77 — 80	..	..	..	6 5 0
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	Nil	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	7 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	..	7 9 4
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	8⅝ — 8⅞	8⅝ — 8⅞	..	..	..	5 15 7
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	80 — 84	80 — 84	..	..	..	4 15 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	½ %	Nil	Nil	¾ — 1	¾ — 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10 1/16 — 10⅜	10 1/16 — 10⅜	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103⅛	102 —103⅛	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	12½ — 13	12½ — 13	..	..	..	5 15 5
40,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	5 5/16 — 5 5/16	5 5/16 — 5 5/16	..	..	..	5 4 8
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½ %	4½ %	4½ %	4½ %	107 —109	107 —109	..	..	..	4 3 4
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	10 %	15⅝ — 16½	15⅝ — 16½	..	..	..	6 1 3
37,500	†Liverpool Overhead Railway, Ord.	10	Nil	½ %	Nil	Nil	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	6⅞ — 7¼	6⅞ — 7¼	..	..	..	6 15 7
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	3 %	Nil	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	Nil
999,930	Do. do. 60,008 to 100,000	10	3 %	3 %	Nil	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	3½ %	Nil	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	..
1,649,930	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	67 — 71	67 — 71	68	..	..	5 12 8
5,732,062	Metropolitan Consolidated	100	1 %	½ %	½ %	1 %	39¾ — 40½	39½ — 40	40½	39⅝	..	2 9 8
2,640,914	Do. Surplus Lands	100	2⅜ %	2⅜ %	2⅜ %	2⅜ %	64 — 66	64 — 66	66⅛	66	..	4 3 4
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	26⅜ — 27½	26⅜ — 27½	27½	26⅞	..	Nil
391,337	Metropolitan Electric Trams., Ord.	1	..	..	4½ %	5%	⅞ — 1	⅞ — 1	16/8	..	..	5 14 3
314,016	Do. do. Defd.	1	Nil	Nil	Nil	..	1 1/16 — ⅛	1 1/16 — ⅛	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1 1/16 — 1 1/8	1 1/16 — 1 1/16	..	..	..	5 6 8
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½ %	4½ %	4½ %	4½ %	98 —101	99 —101	100½	..	+1	4 8 3
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	6 %	122¼—124½	122¼—124½	124	123⅝	..	4 16 5
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	..	5 %	5 %	9 1/16 — 97⅛	96½ — 97⅝	97	96⅜	..	5 2 7
245,500	Potteries Electric Traction	1	4 %	4 %	Nil	..	⅞ — 1 1/16	⅞ — 1 1/16	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	⅜ — ⅝	⅜ — ⅝	..	..	..	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½ %	4½ %	4½ %	4½ %	80 — 83	80 — 83	..	..	..	5 8 5
37,350	Telegraph Construction and Maintenance	12	15 %	17½ %	15 %	17½ %	37 — 39	38 — 41	..	..	+1	5 9 5
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	101 —103	101½ —103½	..	..	+ ½	3 17 4
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	..	5 %	..	101 —102	101 —102	101⅝	101¼	..	4 18 0
2,800,000	Do. do. 4½ % Bonds	..	..	..	4½ %	4½%	95 — 97	95 — 97	95⅝	95¼	..	4 12 9
4,900,000	Do. do. 6 % Income Bonds	..	..	..	..	..	38 — 40	38 — 40	39⅛	39	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	10 %	5 %	Nil	⅛ — ¼	⅛ — ¼	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	6 %	3 %	1 — 1½	1 — 1½	..	..	..	10 0 0
245,495	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	..	..	6 3 1

ELECTRICITY SUPPLY COMPANIES.

30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10%	10 %	10 %	10 %	6⅞— 7⅜	6¾— 7⅛	..	..	..	6 15 7
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6¾— 7⅛	6¾— 7⅛	..	..	..	4 14 11
400,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	100½	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	3⅜— 4⅛	3⅜— 4⅛	..	..	..	5 19 5
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4 %	4½%	4⅛— 4⅜	4⅛— 4⅜	..	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4 %	4½%	3⅞— 4⅛	3⅞— 4⅛	..	..	..	5 5 11
415,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 97 xd	95 — 97	..	..	..	4 2 6
9,496	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	4½%	3⅛— 3⅜	3⅛— 3⅜	70/-	..	— ⅛	6 4 2
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	97 — 99 xd	97 — 99	..	..	..	4 10 11
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	7 %	11 — 11½	11 — 11½	11⅝	..	..	6 1 9
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11⅜ — 12¼	11⅜ — 12⅜	..	..	+ ⅛	4 16 0
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	120 —124	120 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	99½—102⅝	99⅜—102½	..	..	..	4 7 10
50,000	County of Durham Electrical Power, Ord.	5	4 %	2 %	Nil	Nil	1⅝ — 2	1⅝ — 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	2⅝ — 3⅛	2⅝ — 3⅛	..	..	..	7 16 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	5 %	5 %	94⅛ — 96⅝	94⅛ — 96⅝	..	..	..	5 3 8
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅜ — 7⅝	7⅜ — 7⅝	..	..	..	6 7 0
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½ — 11	10¼ — 11	10⅝	..	..	5 9 1
400,000	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	104½—107⅛	104½—107⅛	..	..	..	4 3 9
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	Nil	⅝ — ¾	⅝ — ¾	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	3 %	Nil	Nil	Nil	1⅝ — 2	1⅝ — 2	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	74 — 77	74 — 77	..	..	..	5 16 11
$8,150,000	Electrical Dev.Co.of Ontario,5%1stMtg.Gold Bnds.	$500	..	..	5 %	5 %	81 — 83	81 — 83	..	..	..	6 0 6
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅛ — 4⅝	4⅛ — 4⅝	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	4⅛ — 5⅜	4⅛ — 5⅜	..	..	..	4 11 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
15,000	Hove, 1 to 15,000	5	9 %	8½%	8½%	8½%	6⅝ — 7⅛	6⅝ — 7⅛	..	..	..	5 19 4
$1,376,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	..	5 %	5 %	10 ½—105½	103½—105½	..	..	..	4 14 9
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	8 %	8 %	6½ — 7	6½ — 7	..	..	..	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
11,000	London Electric Supply Corporation, Limited,Ord.	3	4 %	2 %	3 %	2 %	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	3 8 1
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	5 17 1
382,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½ %	4 %	4 %	4 %	89 — 92 xd	89 — 92	..	..	..	4 7 0
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8 %	6½%	5 %	5 %	3⅛ — 3⅜	3⅛ — 3⅜	..	..	..	6 13 4
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅛ — 4⅜	4⅛ — 4⅜	..	..	..	4 17 4
235,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4 %	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
248,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	82 — 85	83 — 86	..	..	+1	4 1 5
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	87⅞— 88⅜	87⅞— 88⅜	88½	..	..	5 12 8
13,585,000	Do. Light and Power Co., Ltd., Common	$100	..	4 %	3½%	4 %	8 7/16 — 90⅛	88⅜— 90⅛	..	..	..	4 8 5
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	7 %	7 %	104⅛—106⅜	104⅛—106⅜	105⅞	..	..	6 11 6
12,000,000	Do. do. 5% 1st Mtg.Gold Bnds.	100	..	..	5 %	5 %	92 — 93	92½— 93½	9	92⅛	+ ½	5 7 3
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4 %	4½%	4½%	97 — 99	97 — 99	..	..	..	4 10 11
130,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	8 %	2½%	..	3⅜ — 4⅛	3⅜ — 4⅛	..	..	..	2 12 9
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	5 %	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 2 7
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	..	5 %	97½ — 99½	97½ — 99½	..	..	..	5 0 6
10,852	Notting Hill Electric Lighting	10	7½%	7½%	7 %	..	11½ — 12½	11½ — 12½	..	..	..	5 12 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	6¾ — 6¾	6½ — 6¾	..	..	..	5 3 8
119,694	River Plate Elcty. Co. Ord.	Stock	2½%	6 %	8 %	9 %	228—232	228 —238	..	..	..	3 15 8
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	6 %	103—113	103 —113	..	..	..	5 6 2
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	100½—102½	100½—102½	..	..	..	4 17 7
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10 %	7⅛ — 7⅜	7⅛ — 7⅜	..	..	..	6 9 0
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅝ — 7⅛	6⅝ — 7⅛	..	..	..	4 14 1
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3 %	3½%	3½%	86 — 88	86 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	..	1½ — 2	1½ — 2	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	3 %	4 %	5 %	5 %	2⅝ — 3	2⅝ — 3	..	..	..	6 18 4
180,100	Do. do. 5 % 1st Mort. Deb.	100	..	..	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	..	⅜ — ⅝	⅜ — ⅝	..	..	..	Nil
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 3/32 — 1 5/32	1 3/32 — 1 5/32	..	..	..	6 16 7
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	¾ — 1	¾ — 1	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	2 — 2½	2 — 2½	..	..	..	10 0 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	81 — 83	80 — 83	80	..	— ½	5 8 5
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	..	5 %	..	⅜ — ½	⅜ — ½	..	..	..	5 14 3
100,000	Westminster Electric Supply, Ord.	5	12 %	10 %	10 %	10 %	7⅛ — 7⅜	7 — 7⅛	7⅛	7⅛	— ¼	6 13 4
51,379	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	5⅛	..	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4½ per cent. December 1st, 1910

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING NOVEMBER, 1910.

THE returns of electrical exports during the month of November show a slight falling-off as compared with the previous month, the figures being—October £395,454, November £390,420. The latter total, however, contains a larger proportion of general business (*i.e.*, exclusive of telegraphic material) than any previous return published by us, and includes £186,000 worth of electrical machinery and some £87,000 worth of cables (exclusive of telegraphic and telephonic cable).

The imports for the month show a considerable increase over those of October, being nearly £18,000 ahead, with almost a record total of £223,955. The import items showing most improvement are electrical goods, lamps, and telephonic and telegraphic material, but the machinery and cable sections show some falling-off in value.

The re-exports, at £23,760, are slightly higher than in October.

Of the purchasing countries, Japan takes the lead, while Canada, New South Wales, India, &c., follow with satisfactory totals.

The most prominent item in the import section is the £60,000 worth of lamps standing to Germany's credit—Germany's total import to this country amounting to £155,000 out of the total from all sources of £223,955.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Country receiving exports and importing.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric lamps and parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	894	500	193	293	387	3,775	...	60	...	245	2,200	8,547
Germany	418	165	39	804	1,475	1,039	33	20	6	155	295	4,449
Netherlands and Java	276	927	108	81	66	277	22	8	...	54	9,052	10,871
Belgium	223	679	98	44	140	1,414	21	232	32	575	3,417	6,875
France and French Indo-China and Africa ...	1,789	...	853	329	21	2,968	113	50	51	341	783	7,298
Portugal	265	78	...	39	...	165	...	8	...	35	...	590
Spain and Canary Isles...	153	64	142	149	3	2,150	494	...	...	...	...	3,155
Switzerland, Italy and Austria-Hungary ...	77	40	79	95	...	1,144	...	506	...	100	250	2,291
Greece, Bulgaria, Roumania and Turkey ...	131	150	50	...	...	1,186	...	68	...	108	55	1,748
Channel Isles, Gibraltar and Malta	15	36	14	...	5	2,438	...	...	...	...	120	2,628
U.S.A., Philippines and Cuba	81	...	121	109	185	248	...	15	1,744	16	4,052	6,571
Canada and Newfoundland	170	3,026	574	1,402	2,542	2,193	1,920	1,700	55	1,159	20,584	35,325
British West Indies and British Guiana ...	137	...	61	229	61	53	...	...	...	71	...	612
Mexico, Colombia, Venezuela and Panama ...	12	518	3	25	...	3,766	...	9	...	51	...	4,384
Peru, Bolivia and Uruguay	94	130	99	68	39	7,354	90	88	...	...	209	8,171
Chile	223	350	23	148	66	1,301	287	59	16	109	144	2,726
Brazil	1,168	1,468	356	876	703	3,330	3,907	632	...	83	2,254	14,777
Argentina	2,328	1,595	627	1,399	...	11,082	102	887	115	3,011	3,121	24,267
Egypt	312	454	131	153	...	2,236	1,134	...	...	622	18	5,060
British West Africa and Congo	27	283	5	46	4	471	...	45	...	140	4,634	5,655
Cape of Good Hope	1,009	2,699	285	306	51	2,719	15	220	31	440	...	7,775
Natal	1,627	7,031	699	498	136	16,087	73	703	...	22	380	27,256
Rhodesia, O.R.C. and Transvaal	1,580	590	389	458	497	11,670	2	67	22	136	79	15,490
British East Africa, Mauritius and Aden ...	43	102	37	65	9	723	...	...	...	121	16	1,116
China and Siam	1,247	596	446	593	2,000	2,811	192	98	176	83	76	8,318
Japan	1,244	27,190	116	346	186	10,238	2,108	...	...	2,373	1,998	45,799
Madeira and Portuguese Africa	87	1,397	425	16	215	990	106	25	...	9	...	3,270
India	2,434	7,802	2,463	1,020	408	11,571	4,074	1,130	29	45	1,059	32,035
Ceylon	164	399	136	95	...	197	116	89	...	12	...	1,208
Straits Settlements and Fed. Malay States	354	1,318	42	66	30	1,048	43	116	...	53	88	3,188
Hong Kong	412	409	87	426	224	1,246	...	42	...	5	...	2,851
West Australia	186	223	21	373	45	1,856	...	544	...	546	9	3,803
South Australia	351	562	193	356	...	3,686	19	11	...	403	232	5,813
Victoria	1,465	7,107	57	516	75	8,796	...	112	49	238	271	18,686
New South Wales	2,936	16,061	226	843	1,145	14,423	107	29	91	1,401	1,120	38,382
Queensland	623	24	93	94	45	7,265	219	64	...	1,186	61	9,674
Tasmania...	8	31	147	...	...	1,174	...	781	...	...	...	2,141
New Zealand and Fiji Islands...	833	2,432	429	118	933	1,798	433	218	11	13	397	7,615
Total, £	25,396	86,166	9,867	12,478	11,696	146,888	15,630	8,636	2,428	13,961	56,974	390,420

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Norway, Sweden and Denmark	535	...	...	6,030	...	1,227	364	448	9	4,227	12,840
Germany	10,405	6,546	692	59,957	3,254	22,185	970	3,738	7,717	40,141	155,605
Holland	...	...	...	2,869	...	60	...	...	261	50	3,240
Belgium	511	955	34	31	284	1,130	...	103	501	5,095	8,644
France	195	251	387	2,328	110	109	...	1,013	3,056	1,579	9,028
Switzerland	72	324	...	350	...	1,109	...	45	202	153	2,255
Italy	...	402	2	4	...	...	...	...	...	4,294	4,702
Austria-Hungary	...	1,314	...	865	160	49	...	192	3,297	142	21,262
United States	6,843	15	279	59	249	5,958	7,382	63	37	377	6,019
Total, £	18,561	9,807	1,394	72,493	4,057	31,827	8,716	5,602	15,080	56,058	223,595

Additional imports: Spain, carbons, £210. Canada, electrical machinery, £150.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above	2,103	1,350	...	4,544	...	3,659	...	301	599	11,204	23,760

TOTAL EXPORTS: £390,420. TOTAL RE-EXPORTS: £23,760. TOTAL IMPORTS: £223,955.

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns.

PROCEEDINGS OF INSTITUTIONS.

Submarine Cables for Long-Distance Telephone Circuits.

By Major W. A. J. O'Meara, C.M.G., M.I.E.E.

(*Abstract of paper read before the* Institution of Electrical Engineers, *London, December 15th*, 1910.)

(*Continued from page* 1047.)

We have long been aware of the great importance the ratio s/k plays in the design of long-distance telephone circuits. In the case of gutta-percha cables, there is certainly no noticeable leakage arising from faulty insulation as in the case of aerial wires; still, the dielectric currents in such cases are appreciable, and practically represent an effective leakage.

In dealing with the maintenance of "coil" loaded cables after they have been laid, the degree of importance to be attached to the uniform spacing of the coils has to be considered. In repairing cables, intermediate lengths have to be inserted at times, but, fortunately, if repairs of this character have to be effected in the "coil" loaded cable, no noticeable impairment in the quality of the speech will result if the coil spacing is disturbed to an extent not exceeding 5 per cent. on either side of the best location from the theoretical point of view. It has been found that when physical conditions impose a variation of not more than 50 per cent. of the spacing for a single coil, no appreciable impairment in the quality of the speech will result, provided the deficiency in loading is made up within the next ten loading sections. The frequency with which repairs have been carried out on the existing telephone cables, as shown in the chart, fig. 5, will convey some idea of the importance of this matter.

Mr. W. Dieselhorst was entrusted by Messrs. Siemens Bros. with the actual operation of laying the cable, and Mr. F. Pollard, submarine superintendent, Dover, was detailed to watch the interests of the Post Office.

The cable ship *Faraday* was employed for the purpose of laying the cable. As a precautionary measure, the ordinary paying-out drum had been replaced by one of larger diameter, and fleeting-knives were also provided in order to prevent the cable from overriding. The new drum was 8 ft. in diameter, and 30 in. wide, and three fleeting-knives were fitted side by side to this rather wide drum to prevent any undue pressure on the loading coils, which would be caused if two turns on the drum were fleeted by one knife only. It was further decided to pay the cable out without passing it under the dynamometer wheel, as is usually the case where deep-water cables are concerned. All bends were avoided by letting the lead from the tank go on to the upper part of the drum, and an open wood trough was fixed from the cable tank to the drum to support and protect the cable between these points. Since the upper part of the drum is nearly in line with the stern sheave, there was no extra bending of the cable over any intermediate supporting sheaves after it had left the drum. The stern sheave on board the *Faraday*, which has a diameter of 4 ft., can be swung out at will to any angle, and this was found to be exceedingly serviceable when turning the ship round at right angles near Abbot's Cliff, and again when the French coast was reached.

The cable was paid into the *Faraday's* tank on May 2nd and 3rd, 1910, and the ship left Woolwich on the 4th with the official representative of the Post Office on board. Operations were commenced at 5 a.m. on May 5th, 1910, by dropping a buoy, to which the shore end was attached, overboard about ½ mile from the South-Eastern Railway Co.'s retaining wall south of the tunnel works. For some distance the cable was laid parallel to the British coast, until a point was reached opposite the landing point, when the ship's bow was turned towards the French coast.

Preparations had been made by the British Administration to assist the *Faradag* in keeping her course, and for this purpose buoys had been placed at intervals by H.M.T.S. *Monarch*, the positions of which were recorded on a chart supplied to the contractors. The importance of these preliminary arrangements cannot be exaggerated. The English Channel is becoming very congested as regards cable routes, and in order to facilitate the maintenance of new telephone cables some alterations in the routes of old cables had been effected on the English coast, so as to avoid the laying of the new cable over old ones; these alterations are shown in the chart, fig. 5. This chart does not show the whole of the cross-channel cables at this point, there being nine cables in all.

The day being fairly clear and the sea smooth, the *Faraday* was easily able to follow the line of buoys, and the laying of the cable went off without a hitch, but a brisk wind sprang up late in the afternoon, and the *Faraday* had a somewhat rough passage back. It was not possible for the *Faraday* to approach nearer than 1½ miles to the French landing-place, as the coast shelves out very gradually. Therefore, when the ship was about that distance from the coast the course was altered, and the remaining portion of cable paid overboard approximately parallel to the coast.

The landing of the shore ends was undertaken by Mr. F. Pollard, Submarine Superintendent, on May 18th, 1910. H.M.T.S. *Alert* was employed for this purpose, and the work commenced at 5 a.m. The shore end on the English coast was first picked up, and the cable coiled into the ship's forward tank. The *Alert* then steamed in as close to the shore as her draught would allow and anchored. A raft was made, and the shore end paid out on to it. The raft was then towed ashore by means of a warp rope, the cable being paid out into the water. This work was completed at 11 a.m., and the *Alert* at once proceeded to the French coast, where the section of cable parallel to the coast was picked up. When the tide permitted the ship steamed in towards the French shore paying out the cable. A short length provided in excess of the actual length required to reach the shore was cut off, and the remainder of the cable was paid overboard at a distance of about 350 yards from the cable hut. When the tide receded this section of the cable was uncovered, and it was possible to carry the end to the cable hut.

Since the bow sheaves of the *Alert* are only 2½ ft. in diameter, it was thought advisable to take special precautions in picking up, and taking the portions of the cable containing the loading coils on board, and again in paying them out, so as to ensure that the loading coils should not suffer any damage. For this reason loading-coil sections were not allowed to ride on the bow sheaves, but tackle was fixed to a derrick, and the coils were carefully lifted over the

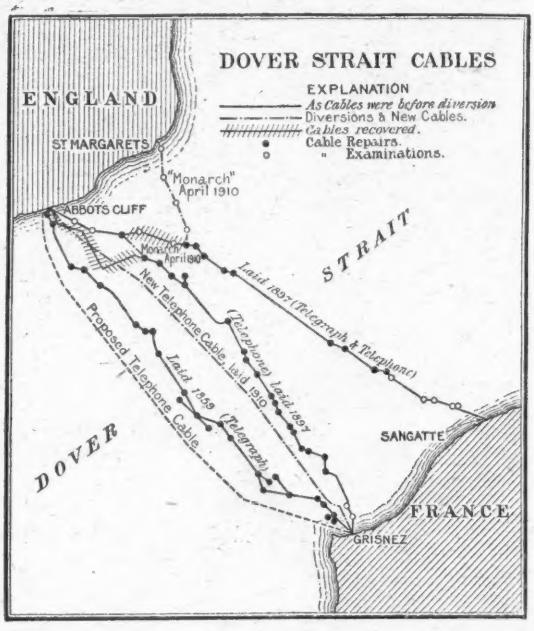


Fig. 5.—Chart showing Cable Repairs, Diversions, &c.

sheaves. However, in the case of the coils in the section of the cable in excess of that required for present needs, the opportunity was seized to ascertain whether the coils would be injured if allowed to pass over the *Alert's* sheaves in the absence of the precautions referred to. This portion of the cable, therefore, was hauled aboard in the usual manner, and a speech test was made on the four conductors of the cable (the ends being looped at the English end) to ascertain whether any damage had resulted. No injury was disclosed in the test; in fact, everything appeared in the best of order.

The cable has been under continuous observation since it was laid, and a large number of tests have been carried out. Particulars of some of them are given in an Appendix. It has, fortunately, been possible to obtain independent testimony on the question of the increase in the range, and in the improvement in the quality of speech transmitted by means of the loaded cable as compared with a similar cable unloaded. Speech tests were made in July last by Messrs. W. R. Cooper, W. Duddell, F.R.S., W. Judd and J. E. Kingsbury, and the results are interesting. The cable was looped at the French end (Cape Grisnez), and the English ends were connected to two telephone sets—one installed in the cable hut at Abbot's Cliff, and the other in the coastguard look-out shelter some 100 ft. distant. Graduated artificial cables were provided so that the listener at the cable-hut could insert various values of the "standard" cable into the circuit, until his own limit of satisfactory audibility was reached. It was possible to insert the "standard" cable values equally at the two ends of the cable (*i.e.*, so as to form a symmetrical circuit in relation to the submarine cable), or unequally, as desired. The results shown in the accompanying table were obtained.

The mean gain by the use of the new cable is, therefore, 17 miles of "standard" cable for the standard of audibility accepted as commercial by the four observers named. When the cables were alone in circuit some of the observers noticed that in the case of the new cable there was a distinct improvement in the quality of the speech as compared with the old cable.

The employment of unloaded 800-lb. copper aerial conductors, such as are in use for the most important long-distance trunk circuits in this country, will render it possible for very satisfactory conversations to take place from call-boxes between centres in England and on the Continent when the added distances from the ends of the cable do not exceed 1,700 miles: that is to say, with landlines of this description well-maintained conversations between London and Astrakan on the Caspian Sea would be possible. In his inaugural address to the Institution,* Sir John Gavey included

* *Journal* of the Institution of Electrical Engineers, Vol. XXXVI page 28, 1905.

a table of equivalents of the various types of unloaded conductors.

Observer listening.	Old cable. Added length of standard cable.	New cable. Added length of standard cable.	Gain by new cable. Miles.
W. R. Cooper...	24 miles symmetrical	48 miles symmetrical	24
W. Duddell ...	24 do.	40 do.	16
		*50 do.	26
		*55 miles at one end	21
W. Judd ...	26 do.	40 miles symmetrical	14
J. E. Kingsbury	26 do.	40 do.	14

*As breakdown limits of hearing.

It may be assumed that in practice aerial conductors of the smaller gauges can be improved by loading two-fold, and the conductors in cables three-fold, so that it is not difficult to determine the centres between which the new Anglo-French telephone cable will provide communication, assuming that a particular type of conductor is employed to complete the circuit.

Although great improvement in speech transmission has resulted from this latest type of cable, yet the new Anglo-French cable cannot by any means be regarded as the last word on submarine telephone cables. Many problems remain to be solved, and they do not appear to be of a character likely to yield a ready answer to

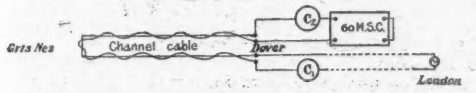


FIG. 6.—ARRANGEMENT OF APPARATUS USED IN CHANNEL CABLE TEST.

those seeking their solution. As in the past, the co-operation of the mathematician, physicist, engineer, and manufacturer are still needed, if an announcement is to be made in this theatre 20 years hence that the progress in the art of telephony has resulted in an increase of efficiency comparable with that which has been achieved during the past 20 years.

The practical engineer recognises fully how much he is indebted to the mathematical investigations of Messrs. Heaviside, Pupin, Perry, Kennelly, and others, in respect of the progress made in the past. There are to-day a number of earnest workers, both in this country and in foreign lands, who are sparing no efforts to render possible the transmission of speech from any one point of the habitable globe to any other. In America, Mr. J. J. Carty, of the American Telegraph and Telephone Co., is engaged in solving the problem of putting the towns of the East Coast of the United States of America into communication with the towns on the West Coast of that great continent. Recently, at Paris, he stated that he hoped

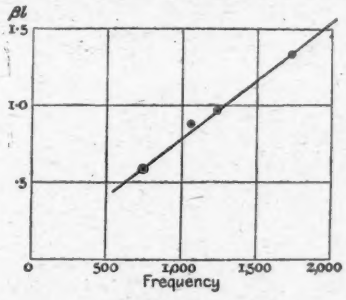


FIG. 7.

to establish satisfactory communication between New York and Denver (distance, 1,700 miles) during the autumn of this year. Experimental investigations are being carried out by, amongst others, M. Devaux-Charbonnel in France, Drs. Breisig and Ebeling in Germany, M. Bela Gati in Hungary, and here in our midst Mr. Gill and his able staff of assistants are vying with Mr. H. R. Kempe, the electrician, and the capable staff engaged on this work at the General Post Office.

APPENDIX I.—*Tests by Mr. L. B. Turner on the Loaded Channel Cable, to determine by Direct Measurement the Sent and Received Currents.*

The experiments were made in the Abbot's Cliff Cable Hut on October 14th, 1910. The high-frequency current used in the tests was supplied from the General Post Office, London, over a pair of telephone wires.

The arrangement of the apparatus was as in fig. 6.

To prevent appreciable reflection-effect at the far end of the circuit it was found that rather more than 20-m. standard cable must be inserted. Actually 60-m. standard cable was used.

The ammeters C_1 and C_2 were Duddell thermo-instruments. Their heaters had resistances of roughly 170 and 4 ohms respectively.

There was some difficulty in obtaining a uniform supply from the alternator, and consequently accurate measurements could not be made.

Frequency p.p.s. Readings.	Frequency p.p.s. Mean.	C_1 milli-amperes.	C_2 milli-amperes.	$\therefore e^{\beta l}$ $(= C_1/C_2)$.	$\therefore \beta l$.	$\therefore$ mean βl.
1,720	—	8·92	2·23	4·00	1·390	—
—	—	6·42	1·80	3·56	1·270	1·33
1,232	—	7·97	3·09	2·57	0·940	—
—	—	8·98	3·38	2·65	0·970	0·96
1,060	—	6·20	2·54	2·39	0·870	0·87
762	—	7·83	4·28	1·83	0·605	—
—	—	7·02	3·91	1·80	0·590	0·60

The graph, fig. 7, is plotted between the mean values for frequency and for βl; l, the length of loop under test, was 40 knots.

To compare these results with the value of β as indirectly obtained by speech tests, we proceed thus. That single frequency which best represents the voice, so far as volume of sound is concerned, has been found to be about 800 p.p.s. From the graph, for this frequency, plus $\beta l = 0{\cdot}63$; *i.e.*, $\beta = 0{\cdot}0158$.

Assuming 800 p.p.s. to be the simple equivalent voice frequency, the value of β per second, as found by speech test comparisons with standard cable, is 0·0169.

APPENDIX IIA.—*Estimated Cost per Circuit of Different Types of Submarine Telephone Cables assuming Copper at £75 per ton and Gutta-Percha at £560 per ton.*

	Estimated cost. Per knot.	Per circuit per knot.	Attenuation constant (β) per knot.
Paper and gutta-percha (two-core) 500 lb. copper, 572 lb. gutta-percha	£1,055	£1,055	0·01401
Anglo-French loaded cable (four-core) 160 lb. copper, 300 lb. gutta-percha	520	260	0·01660
Composite core. Paper + india-rubber + gutta-percha (two-core) 900 lb. copper, 280 lb. india-rubber, 1,400 lb. gutta-percha) ...	1,145	1,145	0·03050
Air-space gutta-percha (four-core) 552 lb. copper, 552 lb. gutta-percha	285	143	0·05170
Danish loaded gutta-percha (four-core) 285 lb. copper, 180 lb. gutta-percha	385	193	0·02960

The above cables do not necessarily represent the most economical utilisation of the materials of which they are constructed. Unfortunately the prices of the two principal materials used in submarine cables are subject to extraordinary fluctuations, and this makes it difficult to adopt a standard design for a given attenuation constant. It will be observed that the costs of the cables have not been based on current prices of copper and gutta-percha.

APPENDIX IIB.—*Statement showing Approximate Costs of Cables of Different Types, but of Equal Telephonic Efficiency* ($\beta = 0{\cdot}0296$).

	Copper, £75 per ton. Gutta-percha, £560 per ton. Whole cable per knot.	Per circuit per knot.
Anglo-French loaded cable,* four cores ... Copper, 46 lb. per mile. Gutta-percha, 116 lb. per mile.	£284	£142
Danish loaded cable, four cores ... ... Copper, 285 lb. per mile. Gutta-percha, 180 lb. per mile.	£380	£190
Paper and gutta-percha, two cores (unloaded) ... ... Copper, 390 lb. per mile. Gutta-percha, 530 lb. per mile.	£977	£977

* In any future type of cable the amount of gutta-percha would be considerably less, and the amount of copper more. This would make the cost of the whole cable very much less.

APPENDIX III.—*Some Foreign "Continuously Loaded" Submarine Cables.*

The first "continuously" loaded cable, having the copper conductor wrapped with a layer of 0·008-in. iron wire on Krarup's plan, appears to have been that laid by the Danish Government, in November, 1902, between Elsinore and Helsingborg. Mechanical and electrical data of this cable are given in the table, p. 1084 The dielectric was gutta-percha, and, except in respect of the iron wrapping, the cable did not differ materially from the ordinary type of submarine cable. This was followed, as will be seen from the table, by various paper-insulated cables having the conductors wrapped with a single layer of 0·012-in. iron wire. In the cable laid in July, 1904, each copper conductor consists of a central wire about 0·089 in. in diameter surrounded by three copper stripe each 0·094 in. wide and 0·020 in. thick. The sectional area of the copper is approximately 0·0124 sq. in., and the weight per knot 285 lb. The iron wrapping consists of three layers of 0·008-in. wire, and the insulator is gutta-percha having an external diameter of 0·354 in. The four cores are laid up with an inner serving of tanned jute and an outer serving of tarred jute yarn to a diameter of 1·18 in., and sheathed with 15 galvanised iron wires of roughly trapezoidal section. The external covering appears to be the usual tarred yarn and compound.

Of the paper-insulated lead-covered cables the Dano-German telephone cable laid between Fehmarn and Lolland in 1907 may be taken as representative. The copper conductor with its triple soft-iron wire wrapping is precisely similar to that used in the Seeland-Samso-Jutland cable described above. The insulator consists of paper cord laid on in an open spiral followed by a close

Table accompanying APPENDIX III.

Cable.	Date of laying.	Length in knots.	Number of conductors.	Copper square inch.	Wrapping of iron wire. Mils.	Insulation thickness in inches.	Lead sheath.	Resistance in ohms per knot of conductor. D.C.	Resistance in ohms per knot of conductor. A.C. $n = (900)$.	Mutual capacity microfarads per knot of conductor. D.C.	Mutual capacity microfarads per knot of conductor. A.C.	Self-induction millihenries per knot of conductor. Wrapped with iron wire.	Self-induction millihenries per knot of conductor. Without iron wire.	β per knot $n = 900$.
Elsinore-Helsingborg	1902	2·85	4	0·0054	7·88	Gutta-percha 0·323	No	8·49	8·79	0·324	0·3030	4·92	1·100	0·0310
Fahmarn-Laaland	1903	10·38	4	0·0155	11·82	Impregnated paper	Yes	3·18	4·79	0·301	0·2660	4·65	0·850	0·0184
Greetsiel (Emden)-Borkum	1903	15·85	4	0·0054	11·82	Air-space paper	Yes	9·03	11·08	0·138	(0·1243)	7·41	1·240	0·0225
Cuxhaven-Heligoland	1903	40·50	2+2/2	0·0186	11·82	Solid paper	Yes	2·53	3·38	0·170	(0·1490)	3·98	0·595	0·0104
Seeland-Samso-Jutland	1904	8·93+11·02	4	0·0124	3×7·88	Gutta-percha 0·355	No	3·98	4·18	0·500	0·4460	8·08	(0·900)	0·0156

The figures in brackets are, however, interpolated or approximately stated.

wrapping of paper ribbon up to a diameter of 0·303 in. Four of the cores so formed are stranded together with the necessary worming and then covered with paper to a diameter of 0·787 in. The diagonal distance apart of the cores, centre to centre, is 0·413 in. The core, after being thoroughly dried, is next sheathed with two layers of lead alloyed with 3 per cent. of tin, each layer being 0·055 in. thick. The lead sheath is seamless, watertight and continuous throughout the entire length of the core. Outside the lead sheath is a double layer of asphalted paper, and a layer of jute and compound. The armour consists of 13 galvanised iron wires or strips of trapezoidal section ½ (0·315 + 0·252) × 0·157 sq. in., and over this is a double layer of jute and compound.

To prevent the destruction of the cable by the puncture of the lead sheath at any point, solid plugs 1 metre long are inserted at every 150 metres.

Resistance per knot of loop, 8·924 ohms ... ... } Continuous current.
Capacity per knot of loop, 0·0872 microfarad ... }
Capacity per knot of loop, 0·0770 microfarad ... } Alternating current.
Inductance per knot of loop, 18·26 to 18·09 millihenries.

In the case of well-constructed inductance coils, the effective resistance is 6 ohms for every 100 millihenries of inductance, *i.e.*, $\rho = 0{\cdot}06\ l$, so that $R = r + 0{\cdot}06\ l$. Formula (2) is a general one, but when l is larger than R (in numerical value), which is usually the case, then—

$$\beta = \frac{R + .14\ L}{63{\cdot}2}\sqrt{\frac{k}{l}}$$

r being the conductor resistance exclusive of the resistance of the inductance coils.

A minimum value is given to β if $r = 0{\cdot}14\ l$, in which case—

$$\beta = 0{\cdot}01183\sqrt{k\ r},$$

and—

$$l = 7{\cdot}14\ r.$$

These two equations are all that is necessary for calculating the inductance which should be given to a cable to make it most efficient telephonically and also to determine the value of β under this condition.

APPENDIX IV.—*Constants of the Anglo-French Coil Loaded Telephone Cable Compared with the Constants of the same Cable without Loading and Continuously Loaded. Overall diameter of Copper* 106·2 *mils.*

Cable core details. Loading.	Overall diameter of gutta-percha.	Constants per knot of loop at 750 p.p.s. Resistance ohms.		Inductance in millihenries.	Capacity in microfarads.	Leakance in mhos.	Attenuation constant. Per nautical mile.	
	Mils.	D.C.	750 p.p.s.				Calculated.	Observed.
Three layers 7·88 mils iron wire, 101·5 turns per in. ...	405*	14·42	15·53	22·00	0·134	$2{\cdot}4 \times 10^{-5}$	0·0241	—
Unloaded	390	14·42	14·42	2·00	0·138	$2{\cdot}4 \times 10^{-5}$	0·0766	—
Coils of 100 m.h. every knot, D.C. resistance, 2·25 ohms, at 750 p.p.s., 6 ohms ...	390	18·50	20·45	102·00	0·138	$2{\cdot}4 \times 10^{-5}$	0·0166	0·0166

* Weight of gutta-percha same as in Cases 2 and 3.

APPENDIX V.—*Mr. H. R. Kempe's Method of Calculating the Attenuation of Loaded Circuits, &c.*

The formula—

$$\beta = \sqrt{\tfrac{1}{2}\left[\sqrt{(R^2 + p^2L^2)(S^2 + p^2K^2)} + RS - p^2LK\right]}$$

is not a convenient one for general use, owing to the fact that the value of—

$$\sqrt{(R^2 + p^2L^2)(S^2 + p^2K^2)} + RS$$

is, in the majority of cases, so very nearly equal to the numerical value of p^2LK that the equation cannot be correctly solved unless the terms are worked out to a very large number of places of figures; also it is preferable to express L, K and S in millihenries (l), microfarads (k), and ohms (ω) rather than in henries, farads and mhos; also, for the cable manufacturer, it is more convenient to deal with a single than with a looped circuit.

The formula in this case becomes—

$$\beta = \frac{\sqrt{k}}{20}\sqrt{\sqrt{R^2 + (5\ l)^2} - 5\ l + \frac{200\ R}{\omega\ k}} + 0{\cdot}000128\sqrt{R^2 + (5\ l)^2} \qquad (1)$$

The value of $\omega\ k$ for ordinary gutta-percha insulated cores may be taken to be 12,500 approximately, so that—

$$\beta = \frac{\sqrt{k}}{20}\sqrt{\sqrt{R^2 + (5\ l)^2} - 5\ l + 0{\cdot}016\ R} + 0{\cdot}000128\sqrt{R^2 + (5\ l)^2} \qquad (2)$$

R being the conductor resistance r, plus the "effective resistance" ρ of the inductance coils; *i.e.*, $R = r + \rho$.

It may be remarked that the equation—

$$\beta = 0{\cdot}01183\sqrt{k\ r}$$

indicates that a properly loaded cable, in relation to telephonic efficiency, does not follow a "$k\ r$" but a "$\sqrt{k\ r}$" law, and it also follows that the efficiency is inversely proportional to the length, and not to the square of the length.

The value of the leakance is an important factor, and could this be reduced tenfold, the value of β could be reduced about 40 per cent.; and, further, if it were possible to reduce the leakance practically to zero, *i.e.*, to make the insulation practically infinite, then the value of β could be reduced 50 per cent., which is the minimum value which could be given to it without reducing the effective resistance of the coils below 6 ohms per 100 millihenries, a result which has so far proved not to be possible.

In comparing the improvement which can be obtained by loading a cable, the fact that there is a normal inductance must be taken into consideration. This normal inductance is about 1 millihenry per knot approximately, but a number of successful experiments have been made to determine its exact value.

The possible improvement from loading diminishes as the conductor resistance diminishes (since, as pointed out, for best conditions $l = 7{\cdot}14\ r$), thus, the possible improvement for a 1-ohm conductor is but one-half that for a 5-ohm conductor. For long-distance speaking in this country, heavy overhead conductors are necessary not only from the point of view of resistance, but also in regard to the effect of low insulation resistance, which, owing to climatic conditions, it is impossible to avoid. Loading of such lines would, even if possible, be of comparatively little value.

The cost, as regards the materials of the core (gutta-percha and

copper), of obtaining a low attenuation constant, increases as the inverse square of the constant, *i.e.*, if we double the length of a cable we double the cost and double the attenuation constant, and to halve this doubled constant the size of the conductor and the thickness of the dielectric must be increased; the cost of this increase would be double that of the original cable, length for length.

The "standard cable equivalent" is, of course, formed on a purely arbitrary basis and has no direct relation to the C.G.S. system, but, on the other hand, the attenuation constant β is based on the C.G.S. units. The actual value of 1 mile of standard cable in terms of β is taken as 0·103 (although there is some doubt now as to this being the correct value). As a practical unit, it is suggested that the "centibeta" might be adopted; thus, instead of saying that the limit of telephonic speech is 47 miles of standard cable, we might say that the limit is—

$$47 \times 0{\cdot}103 \times 100 = 480 \text{ centibetas.}$$

Standard cable boxes might with advantage be adjusted to exact "centibeta" units, though there is at present some difficulty in doing this, owing to the uncertain element of "leakance," at telephonic frequency, coming in.

The word "dampance" might be used as meaning the transmission value of any particular line; thus we should say the "dampance" of the Channel cable—

$$= 34 \text{ centibetas.}$$

The use of such a word as "dampance" is in line with modern practice where we speak of resistance, leakance, reluctance, &c.; "loadance" has been used by Jacob (of Siemens), and probably "insulatance" (for insulation resistance) will follow in due course. The word "improvance," in connection with the improvement in efficiency of a cable by loading, is also a convenient one. "Improvance" by loading in the Channel cable = 3·2.

(To be concluded.)

PUBLIC LIGHTING IN THE CITY OF LONDON.

(*Concluded from page* 1013.)

Central Lighting by High Standards.—Farringdon Street.

This street, which extends from New Bridge Street at Ludgate Circus to Farringdon Road at the junction with Charterhouse Street, may be classed amongst the City wide main thoroughfares having a double line of traffic, in this case chiefly from Blackfriars Bridge to the North of London.

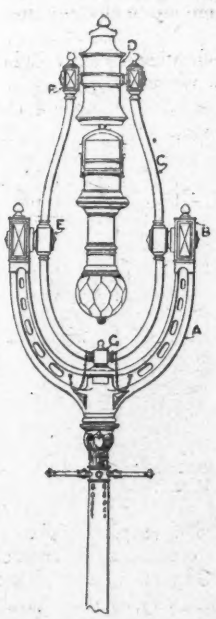


Fig. 4.

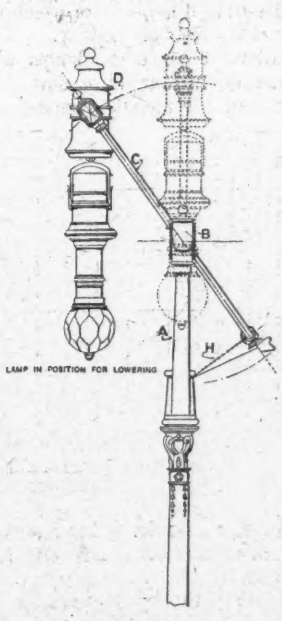


Fig. 5.

Details of Arc Lamp Carrier.

To regulate and direct the traffic and contribute to the safety of pedestrians crossing the roadway, central rests, with the present-day fast traffic, constitute an essential feature.

The new flame arc lighting of this street has therefore been effected by lamps supported on high central standards placed on the roadway rests recently provided by the Corporation of the City of London. These new standards (supplied by Messrs. Macfarlane) are of an artistic and massive design, in keeping with the general appearance of the street. The base above ground is approximately 2 ft. square × 5½ ft. high, surmounted by a circular column tapering from 8 in. diameter at the enlarged make-up on the base to 5 in. diameter at the top.

The footing consists of a rectangular foot about 20 in. square, flanged at the bottom about 3 ft. below the base, the whole consisting of one casting, bolted down to H girders secured in a concrete foundation.

The arc lamps installed are of the latest and most powerful 12½-ampere Excello flame type, the lamps being fitted with inner dioptric deposit-free globes within very slightly opalescent spherical outers. The candle-power distribution around these lamps is of a nature most suitable for street lighting, the candle-power near the horizontal exceeding 4,000 candles. The height of the lamps above the roadway being 25 ft. 6 in., and the distances apart about 180 ft., an excellent illumination is obtained.

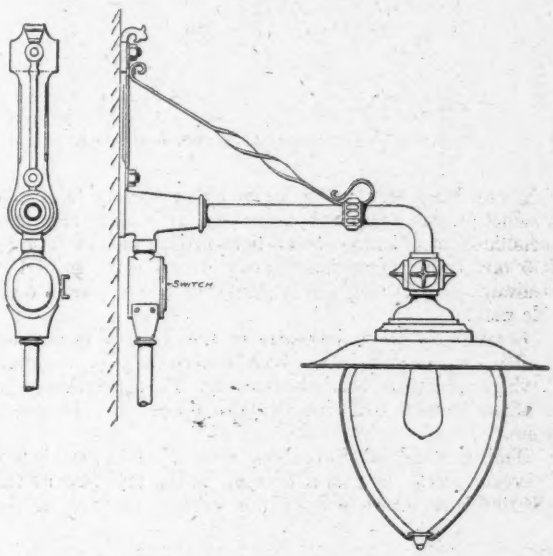


Fig. 6.—Incandescent Lamp Bracket.

A novel feature of this example of post lighting is the central harp carrier, which was designed and manufactured in the workshops of the City of London Electric Lighting Co., Ltd.

Reference to figs. 4 and 5 shows the general appearance and construction of these carriers, and also their position when adjusted for lowering the lamps.

The top of the standards terminates in a spigot, over which is fitted the bell fitting forming the base part of the outer, fixed, fork-shaped, webbed casting A, having at the top rectangular trunnion boxes B. The inner harp carrier C, consisting of steel tubes with boxes (E and F) and footing G attached, is thus free to rotate between the carrier arms—within the limits provided by the draw wire and catch chains H. At the apex of the harp is pivoted the bell weather hood D, within which is fitted the well-known London Electric Firm's contact device and automatic locking gear. The lamp leads and winch wires are entirely confined within the forked casting and harp tubes, the whole thus providing a central carrier, which permits the lamp to be lowered for cleaning and trimming on the ground level, the arrangement being devoid of any unsightly or exposed projecting parts such as have hitherto been found necessary to effect the same purpose.

The bases of the columns are provided with two doors giving ready access to the lamp isolating switch, automatic cut-outs and winch boxes, all of which are conveniently fitted in the ample space of the base.

Farringdon Street at its Northern end is crossed by Holborn Viaduct, the latter being supported on the kerb line by massive granite columns; these, with the limited headway above the road level, render effective arc lighting immediately below the Viaduct impossible. This area had, therefore, to be illuminated by metallic-filament lamps, and

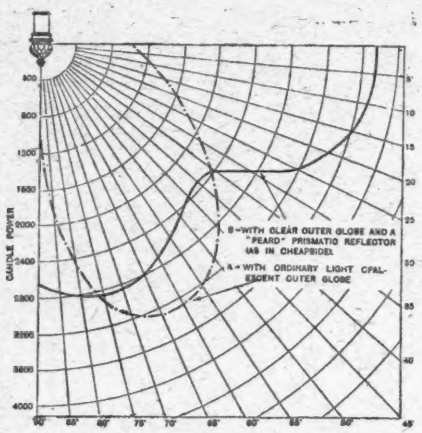

CANDLE POWER
B=WITH CLEAR OUTER GLOBE AND A "PEARD" PRISMATIC REFLECTOR (AS IN CHEAPSIDE).
A=WITH ORDINARY LIGHT OPALESCENT OUTER GLOBE

Diagram 1.—Oriflamme 12½-amp. Arc Lamp.

this has been very well effected by supporting from the Viaduct girders suitable lanterns and reflectors containing metallic-filament lamps—two 3-light fittings each containing 200 c.p. being hung immediately over the centre of the roadway, and one single-light fitting of 100 c.p. over each side walk.

Immediately below the centre of the Viaduct is a small traffic rest, on which has been erected a pilot standard having a double bracket (see fig. 1) supporting two pendant lanterns each containing a 50-c.p. metal-filament lamp.

Similar standards have been erected on the small rest between Fleet Lane and Seacoal Lane, and also at the Charterhouse Street end of the lavatory entrance at the

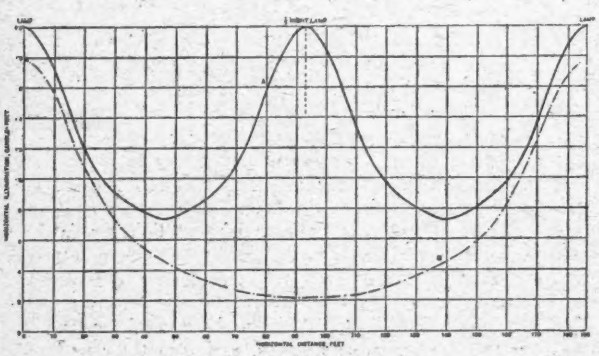


Diagram 2.—Horizontal Illumination Curve, Cheapside.

north end of Farringdon Street, the candle-power of the lamps in the latter instance, however, being increased to 200 candles.

At the end of Snow Hill near its junction with Farringdon Street, and also at the rest at the south-east end of St. Bride's Street, near Ludgate Circus, Oriflamme arc lamps on suitable bracket tops have been erected, attached to the old City posts which were originally fitted with hexagon lanterns containing 10-ampere open arcs.

The effect of these changes has been to produce throughout the length of Farringdon Street a brilliant and well distributed illumination far exceeding both the intensity and equality of the light previously given by the old gas and electric lamps, coupled with a very material reduction in the cost of lighting. This reduction has primarily resulted from the enormous increase in the effective candle-power of the new lamps installed compared with those formerly in use, thus allowing a material reduction in the number required, and also from the improved disposition and height of the lamps, which in many cases now illuminate a considerable distance up cross streets, thus extinguishing a number of old lamps therein. The changes effected may be summarised as follows:—

New Lamps Erected.—Excello arcs, 7; Oriflamme arcs, 2; metallic-filament lamps, 8; total new lamps, 17.

Old Lamps Displaced.—10-ampere open arcs, 12; L.P. gas burners, 19; H.P. gas burners, 3; total, 34.

Farringdon Street (width, 100 ft.).—Length of street, 1,567 ft.; length of side streets and courts lighted, 595 ft.; total length of thoroughfare lighted, 2,162 ft.

Walking either from Fleet Street or New Bridge Street, where the most recent forms of H.P. gas lamps have been

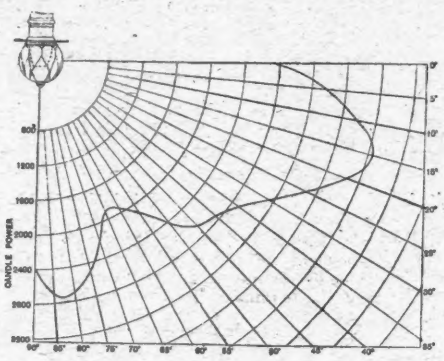


Diagram 3.—Excello 12½-amp. Arc Lamp.

erected on side brackets and standards, one is immediately and forcibly struck with the vast superiority of the new electric central lighting in Farringdon Street, as regards both the degree of illumination and the general appearance of the lamps and standards, which are far more in keeping with the nature of an important thoroughfare than those in either of the former streets.

The Bracket System.—Paternoster Row.

This street is typical of the many narrow minor streets in the City having a roadway for a single line of traffic and a number of narrow courts and passages leading therefrom. As is well known, these streets are mostly lighted by upright L.P. incandescent gas burners enclosed within the old rectangular-framed lanterns, of which there are many hundreds in the side streets of the City.

Eleven of these gas lamps which were recently lighting Paternoster Row have now been replaced by nine electric lamps of the metallic-filament type. These lamps, each of

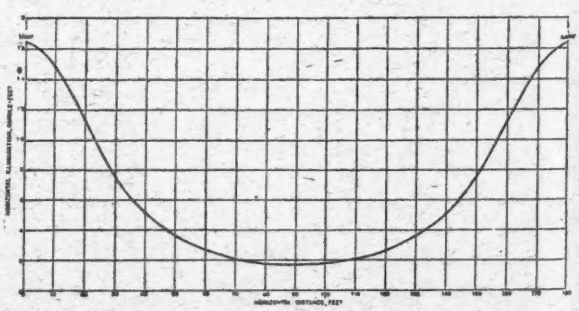


Diagram 4.—Horizontal Illumination Curve, Farringdon Street.

75 c.p., are enclosed in pear-shaped clear glass globes provided with internal reflectors and external white enamelled shades (specially made for the City of London Electric Lighting Co. by Mr. Haydn Harrison), the combination giving an actual effective candle-power of 95 candles per lantern.

The general appearance of one of these fittings and their bracket supports, with switch boxes attached, is shown in fig. 6. The height of the lamps is from 12 ft. 6 in. to 14 ft. above the footway, according to the height of shop facia boards and other controlling circumstances. This combination makes a simple and efficient means of solving the side-street lighting problem on economical lines.

The constancy and uniformity of candle-power, combined with the whiteness of the light, produce a pleasing appearance and a good even general illumination, perfectly free from shadows.

The increase in effective candle-power, and improved disposition of the lamps in the street, have enabled the Corporation to dispense with several lamps in side courts, the result being

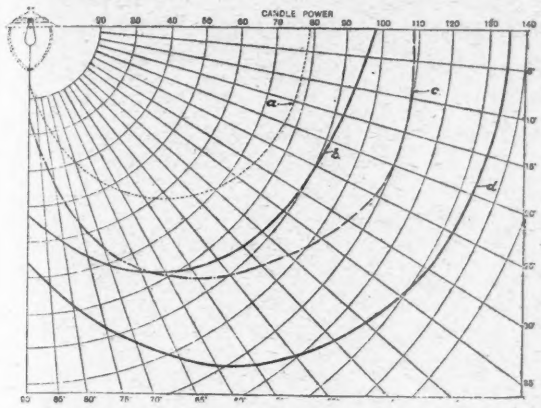


Diagram 5.—Polar Curves of Metallic-Filament Lamps.

that 15 gas lamps have been extinguished on account of the nine new electric lamps installed. The marked improvement in the illumination and general appearance has thus been accompanied by a very material saving in the cost of lighting the street.

The width of this street is about 20 ft., and its length 776 ft., to which must be added about 220 ft. for the side courts and passages directly illuminated by the new lamps, thus making a total of 996 ft. of thoroughfare lighted.

Diagram No. 3 shows the candle-power polar curve of the 12½-ampere Excello lamps with dioptric inners, supported on high central standards in Farringdon Street.

Diagram No. 4 shows the resultant horizontal illumination along the kerb line between the two lamps. It will be noted that this street is also excellently lighted with an average illumination of ·67 candle-foot, the maximum being 1·64 candle-feet and the minimum ·17 candle-foot.

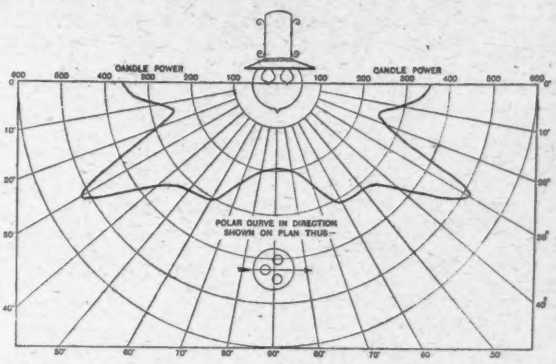


Diagram 7.—Polar Curve of 300-c.p. Metallic-Filament Lamp Fitting.

Diagram No. 5 shows the candle-power polar curve of the metallic-filament units employed, the dotted lines *a* and *c* showing the candle-power of the 75 and 100-c.p. lamps respectively, the tests being on the isolated lamps without fittings or reflectors.

The full lines *b* and *d* show the measured candle-power of the complete fitting containing these lamps, and clearly show the improvement due to proper arrangement of the reflectors, shades and globes used.

Diagram No. 6 shows the horizontal illumination along

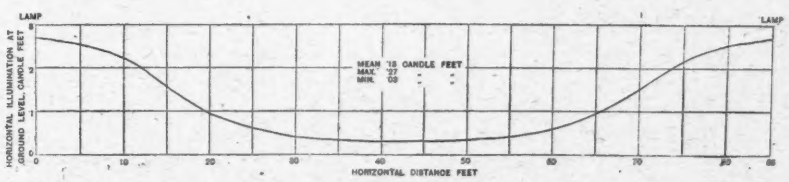


Diagram 6.—Horizontal Illumination Curve, Paternoster Row.

The old gas lamps have in the past no doubt done good service, but the metallic-filament lamps with their steady white light, uniformity and maintenance of candle-power, coupled with the entire absence of shadow, are such a decided advance upon the fluctuating greenish light of the old L.P. gas lamps, with the general inequality and erratic conditions of the gas mantles, and the many shadows cast by the old framed lanterns, that there can be no doubt as to the ultimate displacement of the old by the more modern lighting unit.

Having now given a general description of the new lamps and their method of installation in the streets, we may turn to a more technical consideration of the photometric qualities of the lamps and the effect of the various fittings, globes and reflectors, employed to improve their effective value for street lighting purposes.

Diagram No. 1, Curve B, shows the candle-power polar curve of the Oriflamme 12½-ampere lamp, as installed in Cheapside, with clear outer globe and Peard reflector. The dotted line A shows the candle-power curve of the same lamp when fittted with the ordinary semi-elliptical slightly opalescent globe usually supplied with these lamps.

Diagram No. 2 shows the horizontal illumination along the kerb line between the Cheapside lamps, Curve A being that due to three lamps alight before midnight; Curve B with the intermediate lamp extinguished after midnight. As will be noted from Curve A, the maximum and minimum illuminations are 2·00 candle-feet and 0·72 candle-foot, the mean illumination before midnight being 1·23 candle-feet. These are remarkably high results as regards the intensity of illumination, coupled with a uniformity unprecedented in street lighting.

the centre of the roadway in Paternoster Row between two 75-c.p. lamps contained in the lanterns previously illustrated and supported on brackets on opposite sides of the street.

Diagram No. 7 shows the candle-power polar curve of the three-light centrally suspended high candle-power fitting in Watling Street containing three 100-c.p. metallic-filament lamps.

Some idea of the great improvement effected in the street lighting by the installation of these fittings is given by the following summary, giving the effective candle-power of the new lamps and the nominal candle-power of the old lamps displaced and formerly lighting the streets comprised in the recent demonstration. The whole of the cost of this installation has been borne by the City Co., with the object of actually proving the wonderful advances effected in electric lamps in recent years.

Street.	Length of streets lighted. Feet.	Nominal c.p. of old lamps displaced	Effective c.p. of new lamps installed.	Increase. Candles.	Increase. Per cent.
Cheapside and Watling Street area	4,372	18,665	43,850	25,185	135
Farringdon Street ...	2,162	28,290	33,075	4,785	16·9
Paternoster Row ...	996	715*	810	95	13·3
Totals	7,530	47,670	77,735	30,065	63

* Note.—For the eleven 65-c.p. gas lamps actually removed in Paternoster Row.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

TARIFF AMENDMENTS.

NETHERLANDS.—With reference to the notice on p. 688 of the ELECTRICAL REVIEW, of October 21st, regarding a new Tariff in the Netherlands, the *Board of Trade Journal* states that the Board of Trade are informed that the proposals of the Netherlands Government in this matter have not yet been laid before the States-General. They understand, however, from indications derived from the Press, that the Bill is expected to have both a protective and a revenue character. It will probably provide for the exemption from duty of food stuffs of general consumption, and of raw material and machinery for use in Dutch factories; for the heavier incidence of taxation on foreign luxuries, the graduation of duty according to the degree of manufacture of each article, and for some relief in respect of articles of a kind not produced in Holland.

NEW PATENTS APPLIED FOR, 1910.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

28,808. "Improvements in electric arc lamps." M. J. RAILING and A. F. ANGOLD. December 12th.

28,820. "Detachable jaws or clamps for carbons used on cinematograph hand-fed arc lamps and the like." M. J. MASON. December 12th.

28,834. "Composition for the use of electric insulating and other commercial purposes." H. P. RASMUSSEN. December 12th. (Complete.)

28,840. "Improvements in and relating to multi-fuse cut-outs." R. ROMEU. December 12th. (Complete.)

28,843. "Improvements in or relating to electrical sound transmitting apparatus." F. OSBORNE and G. R. WHITE. December 12th.

28,881. "Improvements in electric clocks." H. CREESE. December 12th.

28,884. "Electric hour meter. J. BESANCON. (Date applied for under Sec. 91 of the Act, December 28th, 1909, being date of application in Germany.) December 12th. (Complete.)

28,888. "Arc lamp electrodes." F. A. M. V. MICHOTTE. (Date applied for under Sec. 91 of the Act, July 15th, 1910, being date of application in France.) December 12th. (Complete.)

28,939. "Improvement in insulators for aerial electric conductors." SIEMENS BROS. & Co., LTD. (Siemens & Halske Akt-Ges., Germany.) December 13th. (Complete.)

28,940. "Improvements in electro-dynamical couplings." SIEMENS BROS. DYNAMO WORKS, LTD. (Siemens Schuckertwerke, G.m.b.H., Germany.) December 13th. (Complete.)

28,973. "Arrangement for varying the tuning of the receivers of electrical apparatus for operating or stopping a number of machines and other devices from a distance." C. WIRTH and C. BECK. (Application for Patent of Addition to No. 5,811 of 1909.) December 13th. (Complete.)

28,986. "Improvements in or relating to electric batteries." R. RUSSELL. December 13th.

28,991. "Improvements in or relating to vapour electric apparatus of the character known as mercury vapour lamps or the like." BRUSH ELECTRICAL ENGINEERING Co., LTD., and A. E. SALISBURY. December 14th.

28,994. "Improvements in electric current gauges or apparatus for measuring the strength of electric current." W. FRISBY. December 14th.

29,005. "Improvements in electric bell connections." W. DIXON. December 14th.

29,052. "Improvements in magnetic separators." H. H. THOMPSON. December 14th.

29,114. "Improvements in means for holding or detaching electric wires on or from insulators." A. WISEMAN, LTD., and J. W. HARRIS. December 15th.

29,119. "Electromagnetic clutch gearing." W. L. SPENCE and A. W. JONES. December 15th.

29,120. "Improvements in the method of cooling the commutators and slip rings of dynamo-electric machines." BRUSH ELECTRICAL ENGINEERING Co., LTD., and M. L. KAHN. December 15th.

29,122. "Improvements in fusible cut-outs for controlling electric circuits." V. HOPE. December 15th.

29,125. "Improvements in apparatus for controlling gas cocks and electric light switches." B. SCHEIDEMANN. December 15th. (Complete.)

29,161. "Improvements relating to commutators for electrical machines." VICKERS, SONS & MAXIM, LTD., A. D. WILLIAMSON and H. F. BROWN. December 15th.

29,168. "Electric transmission of power by polyphase currents." SIEMENS BROS. DYNAMO WORKS, LTD. (Siemens Schuckertwerke, G.m.b.H., Germany.) (Application for Patent of Addition to No. 28,081, 1910.) December 15th. (Complete.)

29,182. "Improvements in or relating to telephone receivers." S. G. S. DICKER. (Automatic Electric Co., United States.) (Date applied for under Rule 13, January 18th, 1910. An invention comprised in Application No. 1,298, dated January 18th, 1910.) December 15th. (Complete.)

29,206. "Improvements in selective electric signalling." J. T. IRWIN. December 16th.

29,242. "Improvements in wireless telephony applicable also to wireless telegraphy." H. G. MATTHEWS. December 16th.

29,261. "Improvements in apparatus for use in electro-plating." S. O. COWPER-COLES. December 16th.

29,270. "Improvements in ironclad oil-break electric switches." SPAGNOLETTI, LTD., and V. F. JOYCE. December 16th.

29,271. "Improvements in mono-telephonic relays." SOCIETE DES TELEGRAPHES MULTIPLEX (Systeme E. MERCADIER). (Application for Patent of Addition to No. 6,928/08. Date applied for under Sec. 91 of the Act, January 26th, 1910, being date of application in France.) December 16th. (Complete.)

29,291. "Improvements in and relating to electrically heated radiators for heating railway coaches and other places." A. CRAVEN. December 16th.

29,302. "Improvements in electric switching devices." H. S. HATFIELD. December 16th.

29,304. "Improvements in and relating to electric alarm systems." P. L. L. LEDUC. December 16th.

29,309. "Improvements in and relating to the control of electric motors." ALLGEMEINE ELEKTRICITATS GES. (Date applied for under Sec. 91 of the Act, December 16th, 1909, being date of application in Germany.) December 16th. (Complete.)

29,314. "Improvements in suspension apparatus for electric arc lamps and other purposes." H. SMITHSON and F. RAVERHILL SHARPE. December 16th.

29,332. "Improvements in sparking plugs for internal combustion engines." C. BINKS, LTD., and C. BINKS. December 17th.

29,338. "Improved means of fixing lamp shades or reflectors on incandescent electric lampholders." R. W. TOWNLEY. December 17th.

29,339. "Improvements in electric current regulating and controlling apparatus, such as electric motor starting and controlling apparatus and the like." J. A. HIRST and P. S. BROOK. December 17th.

29,341. "New or improved electrical fuse." B. DARBY. December 17th.

29,378. "Improvements in and relating to electrical controlling mechanism." C. G. LOHAY. (Application for Patent of Addition to No. 14,431 of 1908.) December 17th. (Complete.)

29,398. "Electrical means for detecting or giving notice of the approach or passage of any ship or submarine vessel past any given point or points desired." F. P. REID. December 17th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

ELECTRIC FURNACES. R. Helfenstein. 26,844. November 29th.

WIRELESS TRANSMISSION AND RECEPTION OF ELECTRICAL ENERGY. B. Dick. 27,424. November 25th.

ELECTRIC RESISTANCES. Clarke, Chapman & Co. and R. C. Harris. 27,922 November 30th.

SYSTEM FOR THE PRODUCTION AND SUPPLY OF ELECTRICITY AT GIVEN TENSIONS BY MEANS OF VARIABLE-SPEED DYNAMOS FOR RAILWAY CARRIAGES. A. A. Crawford. 27,604. November 26th.

Stained-Glass Lighting.—A stained-glass window, seen by the light of day against a clear, bright sky, is a beautiful object of art as was realised by our forefathers in the days of the great cathedral builders. The same window at night is as dead and dismal as the cold remains of some destructive conflagration.

The electrical engineer is not likely to be troubled with the lighting of such church windows *in situ*, but cases will sometimes arise where it is desired to display stained glass—in shops, museums, or elsewhere—and such a one has recently been dealt with at the South Kensington Museum, to which Mr. Pierpont Morgan has lent, besides a large collection of other works of art, some valuable specimens of stained glass. This has been arranged in Gallery No. 21, which is on the ground floor in the immediate neighbourhood of the entrance to the Museum from the Exhibition Road. The leaded glass is fixed in frames (which present an anything but temporary appearance) which form projections round five of the windows in this gallery. These frames support the glass at a height of 4 ft. 6 in. from the floor, and extend upwards for another 9 or 10 ft. Including the plain glass, with which spaces round some of the specimens have been filled in, the area in each window is about 90 sq. ft.

As those who have had experience in lighting illuminated signs or other devices will be aware, the principal trouble in such lighting is to avoid the bright filament of the lamp showing as a bright spot through the glass and producing an uneven patch of light. To avoid this very diffused lighting is necessary, either by indirect lighting or by breaking up the direct rays of light through ground glass or other medium.

In the present instance the former method is adopted, and, as the frames stand some 2 ft. from the windows of the building, there is sufficient space to apply this very effectively. As it was necessary that the stained glass should be seen by daylight, no permanently fixed reflecting surface could be placed behind, as this would have obstructed the natural light. To avoid doing so large blinds of a shiny, white calico have been used, which can readily be drawn down at night and rolled up again in the morning.

The light is supplied by 40-watt metallic-filament lamps in short angle-brackets. Two of the windows which contain particularly dense and deeply-coloured specimens have each 18 such lamps, the lighter windows having only 12 or 14 each. The brackets are mounted on teak battens, faced with Uralite, which are screwed to the uprights and cross-timbers of the frames, so spaced as to obtain a uniform illumination. The two sides of each batten are bevelled off from the back so as to provide a sloping surface to which 4-in. strips of Uralite are screwed. These Uralite sides not only assist in throwing the light towards the blind, but they also cut off any direct rays which might strike the eyes of those examining the glass.

The wiring from the two or three batteries in each frame is looped-in at a ceiling-rose near the top, from which there is a flexible connection to a wall-plug fitting on the run of conduit containing the circuit wires. The latter lead back to a six-way switch-and-fuse distribution board, from which the lighting of each window is controlled.

As the result of this lighting, those of the general public who are only able to visit the museum on the three nights a week on which it remains open until 10 p.m., are now able to study and enjoy these beautiful old works; and, if the colours are not always exactly reproduced by the artificial light, they are quite sufficiently so to justify fully the expense incurred both in the installation and maintenance of this extra lighting.

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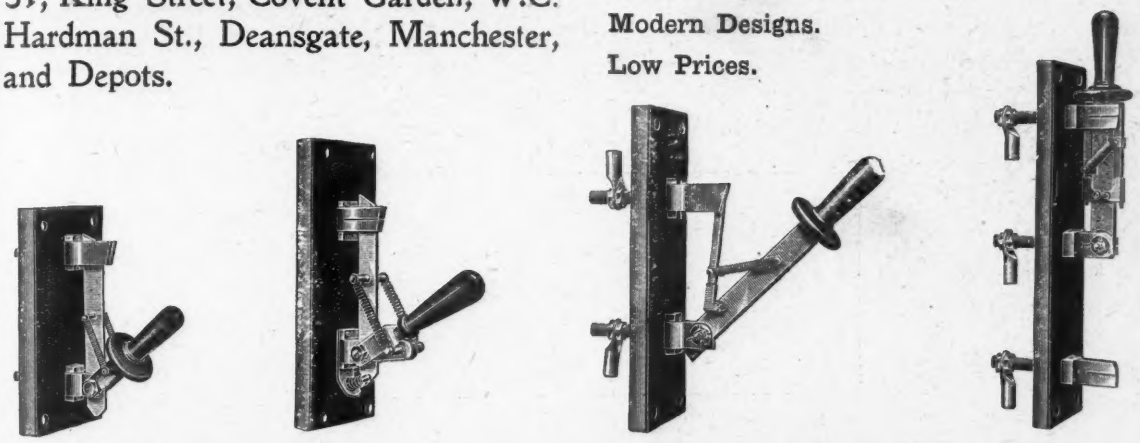

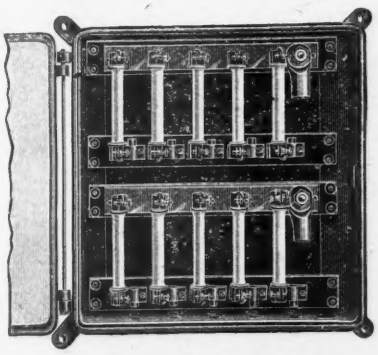

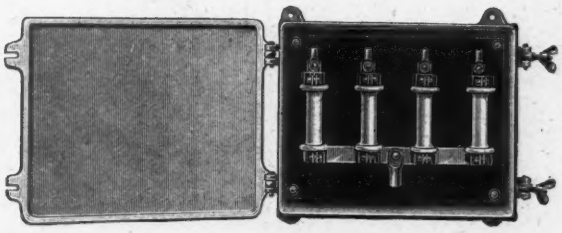

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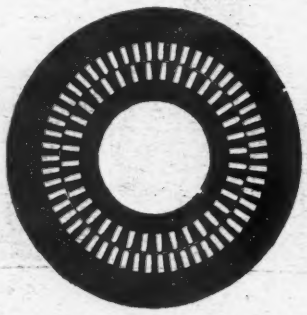

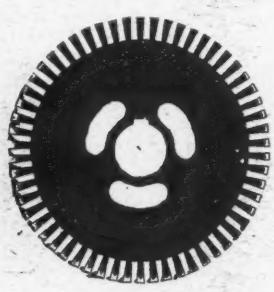

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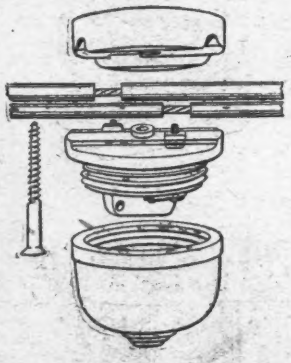

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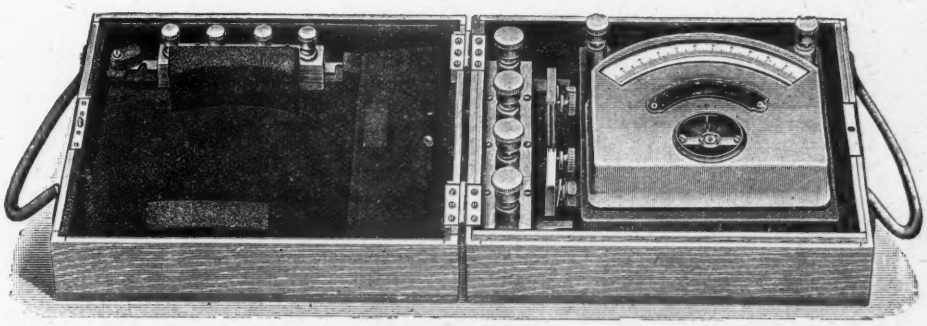

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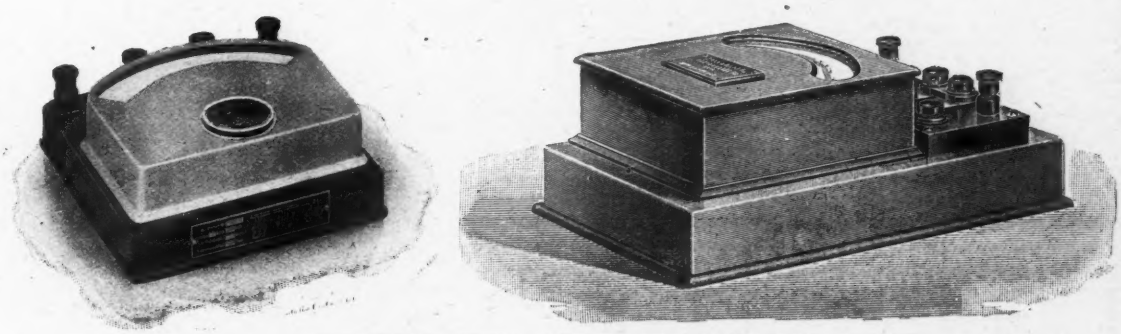

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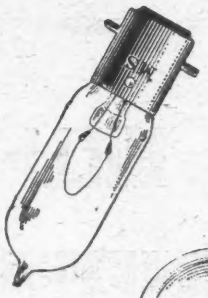

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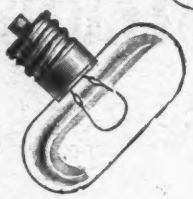

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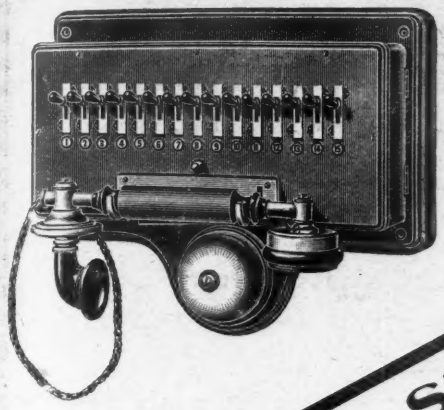

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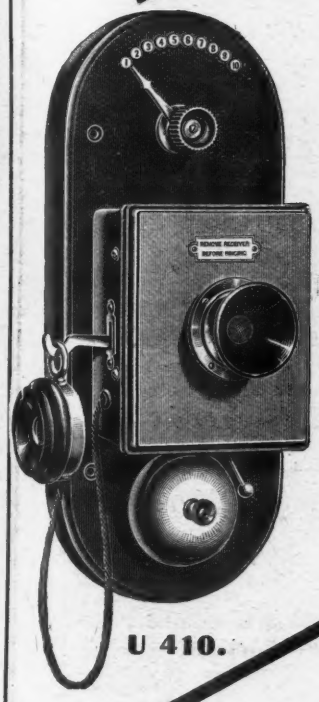

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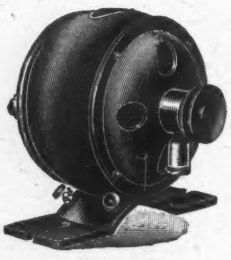

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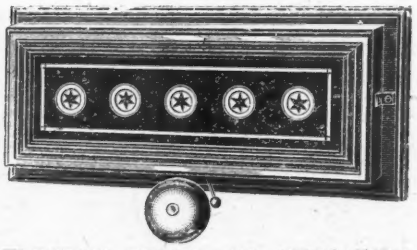

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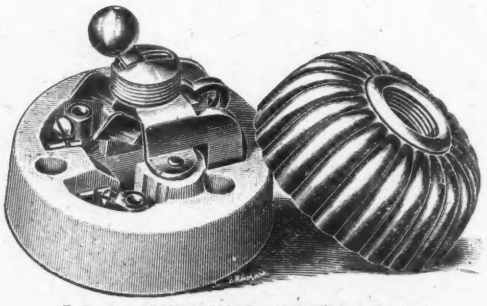

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EDWIN PARKES,
Town Clerk.

Town Hall, Eccles,
28*th December*, 1910. 1326

COUNTY BOROUGH OF OLDHAM.

General Manager of Tramways.

THE TRAMWAYS COMMITTEE of the Oldham Corporation invite applications for the position of General Manager of their electric tramways at a commencing salary of £350 per annum.

Candidates must have had experience in the management of electric tramways and in traffic superintendence.

A list of duties can be obtained on application to the undersigned.

Applications, stating age and present and past employment, with copies of not more than three recent testimonials, and endorsed "Tramways Manager," to be delivered at my office not later than the 9th JANUARY next.

Canvassing, either directly or indirectly, will be regarded as a disqualification.

J. H. HALLSWORTH,
Town Clerk.

Town Hall, Oldham,
December 23rd, 1910. 1279

(Continued on next page.)

SITUATIONS VACANT.—*Continued.*

GLASGOW CORPORATION TRAMWAYS.

APPLICATIONS are invited for the position of Improvers in the power station and rotary converter sub-stations of the Tramway Department. Applicants must have had at least three years' practical engineering experience, and, in addition, a good theoretical training in electrical engineering.

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SITUATIONS VACANT.—*Continued.*

WANTED, Meter Tester with good theoretical and practical training, and experience in testing C. and H. Meters. Commencing wage 30s. per week.—Apply at once giving age and full particulars with copies of not more than three testimonials, to H. R. BURNETT, Electricity Works, Barrow-in-Furness. 1257

WANTED at once, Reliable Working Foreman in small works, manufacturing and repairing all kinds of small Electrical Machinery and Apparatus. A skilled mechanic and good disciplinarian is important, together with knowledge of quick production.—Qualifications, age and salary expected by letter to S. BOTTONE & SON, LTD., Wallington, Surrey. 1172

WANTED at once, smart Counter Assistant for wholesale Electrical Warehouse, with knowledge of Electric Lighting Accessories. State wages, past experience, &c.—1217, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Engineman for Power Station in the county of Durham, to attend to generating plant, switchboard, and pumps. Only those who have served an apprenticeship in engineering works, and have had central station experience with high-speed enclosed engines, and three-phase alternators running in parallel, need apply. Eight-hour shifts. Present wage 39s. per week, with free coal, and 3s. per week house-rent allowance to married men.—Apply, stating age (which should not be less than 30 years), experience, and when at liberty, with copies of testimonials, to 1324, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED smart Improvers for testing electrical heating apparatus. Write stating experience, age, and wage required, also particulars of college training, if any, to EDISON AND SWAN CO., Engineering Department, Ponder's End. 1280

WANTED at once by large London engineering firm, a young and energetic Salesman thoroughly familiar with electrical apparatus; man who has had some workshop and test-room experience preferred.—State age, experience and salary required, to 1274, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, two smart young Engineers, with good knowledge of arc lamps, small motors, and heating and cooking apparatus, capable of pushing sales in these directions.—Reply by letter, stating experience, salary required, to THE ELECTRICAL CO., LTD., 122-124, Charing Cross Road, W.C. 1316

WIRELESS Operator-Installer wanted for ship work, &c. Must be fully competent man.—Reply, stating experience and salary required, to 1275, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WIREMAN wanted, with general experience of both casing and tubing; one with knowledge of telephones and bells preferred, would also be required to make himself generally useful and assist in the running of the plant. Wages £40 a year, with board, lodging and washing, subject to 3 p.c. deduction under the Asylums Officers' Superannuation Act, 1909.—Apply by letter only, giving full particulars, and stating age, to "WIREMAN," c/o the Medical Superintendent, Cornwall County Asylum, Bodmin. 1318

WIREMEN, well up in tube work, W. district.—Apply 1314, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of Advertisers using a number in any way be disclosed.

SITUATIONS WANTED.

Latest time for receiving 9.30 a.m., Thursday.

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ADVERTISER (24) desires position: home or Argentina. Railway, tramway and lighting experience; technical training; A1 refs.; speaks Spanish.—H., 25, Finborough Road, South Kensington. 1194

CAR Painter seeks situation, good liner, writer and finisher. Piece or day work.—BAKER, 17, Whitehall Road, West Bromwich. 1175

ELECTRICAL Engineer, young, wishes to improve his position. Good general experience, shops, college, traction.—1247, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL and Mechanical Engineer desires situation. Take charge of plant, &c.—For references, apply, stating salary, 1227, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICAL Engineer (34) technical training, central station and contracting experience, 6 years out East, desires position; home or abroad.—WASHINGTON, Durley Road, Bournemouth. 1309

ELECTRICIAN (married) desires change. Excellent references. Would take charge of plant.—1226, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ELECTRICIAN; dynamos, motors, accumulators, arcs, wiring, gas engines; good mechanic.—CAMKEN, 154, Ilbert Street, Queen's Park, W. 1298

ELECTRICIAN, competent, all branches, seeks situation.—ELECTRICIAN, 6, Beckett Avenue, East Ham. 1305

ELECTRICIAN requires appointment, charge of private plant, town or country; experienced oil, gas (suction), steam, own repairs; excellent testimonials; moderate salary.—RYDER, Bishopstone, Shrivenham, Berks. 1300

ELECTRICIAN'S Improver (20), good references.—47, Walsingham Road, Clapton, N.E. 1303

ENGINEER-Electrician (32), requires charge of plant; experienced; accumulators, gas, steam, oil engines, dynamos, motors, telephones, pumps, &c.; repairs; highest references.—J. W., 102, Hubert Road, Wimbledon. 1299

EXPERIENCED Manager, Engineer, Representative (44), highest credentials, seeks responsible position; £200.—CRAMP, 10, Spencer Road, Dartmouth Park, N.W. 1301

EXPERT Instrument Maker (31), desires position, electrical, scientific or experimental work.—1180, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

EX-Post-Office Lineman wants employment; telegraphs, telephones and exchanges, cables overhead lines, &c.—1297, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

(Continued on next page.)

SITUATIONS WANTED.—*Continued.*

FOREMAN Wireman, with long experience in all branches, including Stannos wiring.—D., 4, Worfield Street, Battersea, S.W. 1293

MR. Ashton Bremner, whose office as Chief Electrical Engineer to the Borough of Burslem has, owing to the Potteries Federation, been abolished, would be pleased to hear of a suitable position as Chief Electrical Engineer and Manager to an Electricity Supply Company or firm of Consulting Engineers at home or abroad.—Address Oswald Road, Oswestry. 1323

MR. F. W. Hickingbotham, of the Electrical Power Storage Company, Millwall, has, after 13 years as Resident Engineer and General Works Foreman, left the Company owing to the office being abolished. Mr. Hickingbotham being now disengaged, would be glad to hear of a suitable vacancy.—Address, 10, St. John's Road, East Ham. 1225

SALESMAN or Stockkeeper (25 years of age) requires situation, wholesale or retail.—A. B., 43, Fernlea Road, Balham. 1307

SITUATION as Improver in large electrical works; 2½ years' experience; age 18.—JOHN NAYLOR, Priestcliffe, near Buxton, Derbyshire. 1287

TWO Electricians, light, bells or telephones; day or piece.—ELECTRICIANS, 26, Eleanor Road, Hackney. 1246

WIREMAN, good pipefitter; dynamos, motors, bells.—SWINNERTON, 5, Wynyard Terrace, Kennington, S.E. 1330

WIREMAN, experienced lighting, power, telephones; excellent refs.—F. H., 47, Shere Road, S.E. 1329

WIREMAN, good all-round, job or permanency.—SAMS, 48, Ingelow Road, Battersea. 1315

WIREMAN, competent, reliable hand, wants work; references.—ELECTRICIAN, 67, Oxley Street, Bermondsey. 1304

WIREMAN (good all-round) requires re-engagement; Simplex, casing or screw barrel; good references.—T., 441, Kingston Road, Merton, S.W. 1306

WIREMAN, young, lighting, power; town or country.—T. H. P., 56, Brunswick Place, City Road, N. 1312

YOUNG Gentleman having had experience in drawing office and works, requires situation as Improver.—Address WILLIS, Fife House, Kingston-on-Thames. 1176

YOUNG Man (23), technical electrical engineering training and workshops, and six years' varied experience, wants situation in London.—R., 71, Crescent Lane, Clapham. 1195

£10 Bonus, good salaried position in central station or private firm. Gentleman (26 years), engineer, technical training, 2½ years' workshops, 6 years' central station; excellent testimonials from past and present employers.—1311, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

PARTNERSHIPS.

ELECTRICAL AND MECHANICAL

ENGINEERING Partnerships Negotiated by JOHN GLOVER AND CO., Engineering Valuers, 17, Collingwood Street, Newcastle-upon-Tyne.

Enquiries solicited from gentlemen desirous of purchasing partnerships in sound concerns, or from firms requiring partners.

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three Consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
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ELECTRICAL Engineer, with small capital, is desirous of purchasing Partnership.—WASHINGTON, Durley Road, Bournemouth. 1310

GENTLEMEN requiring Partnerships and well-established Engineering concerns, open to receive Partners with capital from £1,000 upwards, are requested to communicate with R. S. PRICE, LTD., Engineering Partnership Specialists, Eldon Street House, Eldon Street, London, E.C. 'Phone, 3806 City.

SMART Young Man wanted, with £200, as Working Partner in Manufacturing Business in London. References required, good salary and share of profits. Particulars at interview only.—Apply 1313, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Partner with £2,500, for sound, old-established London engineering business, electrical and mechanical work.—U., 947, SHELLEY'S, Gracechurch Street, E.C. 1284

WANTED, Mechanical and Electrical Engineer, or Gentleman willing to invest in works, &c.—1264, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

AGENCIES.

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ADVERTISER, concluded agency with leading firm electric fittings manufacturers, desires additional Agencies for accessories, cables, conduits, lamps, dynamos, on sharing expenses and commission terms. Good connection and highest credentials.—1190, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

CANADIAN Agent.—For nine years connected with the electrical trade of Canada, is open to represent a manufacturer of Carbon, Tungsten and Mazda filament lamps with Edison bases. Some other specialities considered.—A. LEVVY, P.O. Box 632, MONTREAL. 1038

(*Continued on next page.*)

FOR SALE.

FOR SALE.

ABOUT 6 MILES OF 19/13 BARE COPPER CABLE.

22 OVERHEAD TRAVELLING CRANES including :—

40 ton 3-motor Electric Crane, 75 ft. span.
Three 30 ton single motor ditto, 42 ft. span.
3-motor 20 ton ditto, 42 ft. 3 in. span, new 1907.
Single motor 12 ton ditto, by Booth Bros., 50 ft. span.
Two 15 ton Steam ditto, by Booth Bros., 40 ft. span.
Two 10 ton Steam ditto, by Lamberton, 47 ft. 6 in. span.
One 10 ton Hand ditto, 43 ft. span, worked from ground.
One 4 ton Hand ditto, 24 ft. 5 in. span, ditto.
One 4 ton Hand ditto, 42 ft. span, worked above.
One 5 ton Hand ditto, 36 ft. span, worked above.
One 3 ton Steam ditto, by Smith, for any span.
And smaller capacity Hand Overhead Cranes in stock.

CATALOGUE of Stock MACHINERY, 2-3000 LOTS, free on application. Inspection invited.

THOS. W. WARD, LTD., ALBION WORKS,
Tel.: "Forward, Sheffield." SHEFFIELD.

SWANSEA HARBOUR TRUST.

THE TRUSTEES invite offers for the following plant :—

One Compound Surface Condensing Double Crank Marine Engine; cylinders 18 in. and 30 in., stroke 24 in., steam pressure 120 lbs.

140 K.W. Generator; 500 r.p.m., 2,000 volts, 100 periods, single-phase, complete with exciter, field regulator, slide rails, &c.

One Robey Engine; 120 lbs. pressure, cylinders 14 and 23½ in., stroke 33 in.

150 KW. Generator; 375 r.p.m., 2000 volts, 100 periods, single-phase, complete with exciter, field regulator, slide rails, &c.

Apply,
WILLIAM LAW,
General Manager. 635

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DYNAMO, by Thomas Parker, 380 amperes, 100-volt, 720 revs., compound, cheap.—W. W. MARTIN, Witton Road, Birmingham. 1125

DYNAMOS, 3000, 1500, 1000 and 750 amperes, at 6 volts ready for delivery; also smaller sizes delivered from stock. Machines let out on hire.—CANNING & Co., Electro-Platers' Engineers, Birmingham.

EIGHTY Motors and Dynamos for sale or hire.—W. W. MARTIN, Witton Road, Birmingham. 1016

FOR Sale, cheap, Electric Loco 4 ft. 8½ in., gauge fitted with two 500-volt 25-H.P. Motors, Controller, Collector, &c., suitable for shunting purposes on private siding.—PERCY HUDDLESTON, 62, Finsbury Pavement, London. 1294

FOR Sale or Hire, high-class Dynamos, Motors, Alternators, Cable and Arc Lamps.—PERCY HUDDLESTON & Co., 72, Finsbury Pavement, E.C. 1295

FOR SALE.—*Continued.*

LARGE Stock of high-class electric lighting type Gas Engines, all sizes and makes; also Dynamos, Motors, Switchboards, &c. Complete installation quoted for upon application. Send your enquiries to HARRY H. GARDAM, Staines. Telephone No. 98. 9385

TWO Parker Dynamos, 110 amperes 225 volts, 880 revs., cheap. —W. W. MARTIN, Witton Road, Birmingham. 1017

3/4 H.P., 230-volt D.C. Motor, also 1/3 H.P., 230-volt D.C. Motor. One Dynamo, 20 amps, 10 volts; also 7 amps. 35 volts. All semi-enclosed. Never been used.—HAMER, Broad Street, Halifax. 1291

20 Enclosed Arc Lamps, two in series on 200-230 volts, in good working order, just removed from large London drapers. Price 15s. each.—THE LONDON ELECTRIC FIRM, Croydon. 1210

BUSINESSES FOR SALE AND WANTED.

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ELECTRICAL Engineer's Business (North of England) for Sale. Good showroom in main street. Turn-over, 1908, £800; 1909, £1200; 1910, £1800. Growing business; small competition; books open to inspection; owner secured good appointment. Price for stock, fixtures and goodwill, £250.—1285, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

FOR immediate disposal, well-established Electrical Contractor's Business in Bristol. Fair counter trade, first-class position, small capital required, £200.—1199, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

ARTICLES WANTED.

WANTED TO PURCHASE FROM ELECTRIC LIGHTING Companies and Electrical Engineers, Dynamos, Motors, Cable, Wire, Instruments, and every description of Electrical Material; also Manufacturers' Surplus Stocks. The bulk being for re-use, high cash prices can be paid.—A. VEREY & Co., Dover. Principal in London three days a week. Telegraphic Address: "Verey, Dover."

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ACCUMULATORS, Second-hand, any type, wanted; also Dynamos and Machinery, Lead Peroxide, Old Copper Cable, Scrap Metals, and every description of Metallic Dross purchased for cash, town or country.—Write A. BROWN & SONS, 142, Lower Clapton Road, N.E. Telephone: Dalston 555. 9013

(Continued on next page.)

ARTICLES WANTED.—*Continued.*

OLD Electric Lamp Tops, Cable and Wire bought for cash.—SMITH & Co., 21, Bride Lane, Fleet Street, London, E.C.

PLATINUM, in any form and quantity, purchased at highest prices by DERBY & Co., LTD., 44, Clerkenwell Road, London.

WANTED, a second-hand Rotary Converter, about 5 to 10 kilowatt capacity, to convert from 100 volts continuous to 70 to 100 volts alternating, from 40 to 50 periodicity; or a 10 kilowatt Alternator, single-phase of 100 volts, 50 periods. Must be a thoroughly reliable machine and in a first-class condition.—Reply, with price and full particulars, to 1283, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

WANTED, Vertical Two-crank Steam Engine, for direct coupling to an alternator, 125 horse-power, 90 lb. steam pressure, 428 R.P.M., must be in first-class condition.—1211, ELECTRICAL REVIEW, 4, Ludgate Hill, London.

MISCELLANEOUS.

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APPLICATIONS for Appointments. Our system gives surest results. Consult us now; you will never regret the trifling outlay incurred.—PREMIER TYPEWRITING COMPANY, Spon Lane, West Bromwich. 1288

LEAD burning, tank-accumulators, autogenous welding, cast-iron and steel, lowest prices.—H., 3, College Street, Putney, S.W. 916

MRS. Alfred E. Izard has accommodation for two Gentlemen as paying guests in her well-appointed home.—For terms, &c., apply to 24, Telford Avenue, Streatham Hill, S.W. 9969

VALUABLE technical matter in cheap and handy form.—"The Engineering Diary," 1d. monthly, from all Newsagents, Booksellers, or the Publishers, St. Stephen's House, Victoria Embankment, S.W. 1109

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KIRCHOFF'S LAWS
AND THEIR APPLICATION.
Paper Covers. 1s. 6d. Post Free.
By E. C. RIMINGTON.
H. ALABASTER, GATEHOUSE & CO., 4, Ludgate Hill, LONDON, E.C.

APPLIED MAGNETISM.
BY
J. A. KINGDON, B.A.
FORMERLY MATH. SCHOL. PEMB. COLL., OXON
75 Illustrations. 7 Tables.
7/6
Post Free.

CONTENTS:
Chap. I., General Principles of Magnetism; Chap. II., The Electro-magnetic Units; Chap. III., Magnetomotive Force of Current; Chap. IV., Magnetic Traction; Chap. V., Generation of Electromotive Force; Chap., VI. Qualitative Magnetism; Chap. VII., The Alternator; Chap. VIII., The Dynamo; Chap. IX., Magnets and Magnetic Leakage; Chap. X., Commutators and Collectors; Chap. XI., Hysteresis and Heating of Armatures; Chap. XII., Alternating Magnetic Flux; Chap. XIII., Electromotors; Chap. XIV., Polyphase Currents and Rotary Fields; Chap. XV., Magnetic Measurements: Chap. XVI., Calculations in Inch Measures. Appendices.—I., Dimensions of Fundamental, Derived and Electro-magnetic Units; II., Symbols and Formulæ. Index.

H. ALABASTER, GATEHOUSE & CO.,
4, LUDGATE HILL, LONDON, E.C.

SECONDARY BATTERIES.
A Practical Handbook for Owners and Attendants.
By AN ENGINEER.
POST 4/= FREE.
H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

NOTICE.

OWING to the many hundreds of replies passing through this Office each week, we would ask those answering Advertisements to be EXTREMELY ACCURATE with regard to the figures WHEN ADDRESSING REPLIES to Box Numbers.

ARE YOU A TARIFF REFORMER?

Perhaps not, but you might be if the effect of a Tariff were to ensure your getting a higher grade of goods. Even without a Tariff we can give you well-seasoned wood and hand polish in all our . . . .

WOOD BLOCKS

instead of green wood and varnish.

BROWN & CO.,

WATERLOO SAW MILLS,

73 to 85, McAlpine St., Glasgow.

Telegrams: "Boxes, Glasgow."
Telephones: 566 and 567 Argyle; 567 P.O.

J. PITKIN & Co.,

PORTABLE

MOVING-IRON. MOVING COIL.

WRITE FOR LISTS.

56, RED LION ST., E.C.

Contractors to
H.M. Post Office, War Office, Admiralty, India Office, Colonial and other

Pneumatic Tubes

Government Departments.
London County Council.
British and Foreign Railways.

Electric Clocks

Telephones { 12,249 Central. 4406 City.

Codes A.B.C.

"Rebesi" (Reg.) System For all Purposes.
Patented Systems For carrying Coins, Papers, Small Parts, &c.
Automatic Constant Current Systems.
High Pressure Systems For Long Distances.
Hand Power and Control Systems.

"REBESI" Patent SYSTEM installed complete with Wiring, Batteries, &c. [redacted] or MASTER CLOCKS, SECONDARY DIALS, and materials supplied only.

"Telegrams: SUPRA, LONDON."

REID BROS., ENGINEERS, [redacted] LTD., 12, WHARF ROAD, LONDON, N.

THE ELECTRIC TRAMCAR HAND-BOOK,

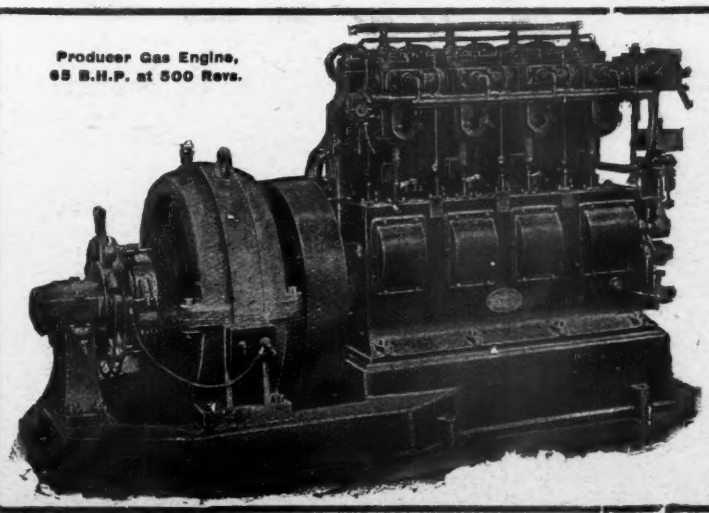
For Motormen, Inspectors and Depôt Workers.

By W. A. AGNEW.

2s. 6d. Post Free 2s 8d.

H. ALABASTER, GATEHOUSE & CO., 4, Ludgate Hill, LONDON, E.C.

Producer Gas Engine, 65 B.H.P. at 500 Revs.



Telegrams: "THEODEM, PATRICROFT." "MORNODESTE," LONDON"

GARDNER
Gas and Oil Engines

Vertical High-Speed Type for coupling direct to Dynamos.

From 5 B.H.P. to 120 B.H.P.

L. GARDNER & SONS, Ltd.,
Barton Hill Engine Works,
PATRICROFT, MANCHESTER.

London: NORRIS & HENTY,
87, QUEEN VICTORIA ST., E.C.
Glasgow Showroom: 45, BOTHWELL ST.

Glovers wish everybody a prosperous New Year

To ensure a prosperous 1911 supply your customers with 'CRYSELCO' Metal Filament Lamps, universally considered the Best British Lamp.

Advertising Literature supplied free.

CRYSELCO, LIMITED,

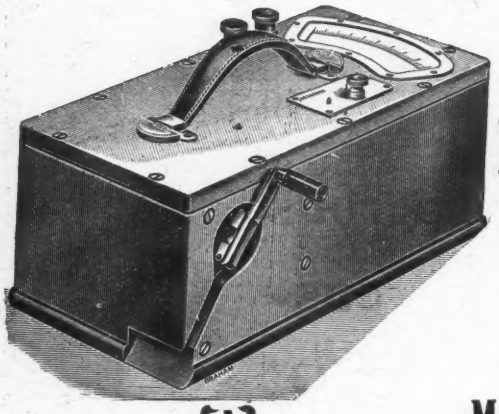
KEMPSTON WORKS, BEDFORD.

Telegrams: "Cryselco, Kempston." Telephone: 177 Bedford.

In the New Year

You will find that the only old-fashioned feature of N.C.S. Electrical Measuring Instruments is the REPUTATION.

The N.C.S. REPUTATION is the result of over 25 years' careful consideration of our customers' requirements, and we prize it so highly that each year we use our utmost endeavours to enhance its commercial value by giving unremitting attention to those details which make for success in the articles we manufacture



1911.

Messrs. Nalder Bros. & Thompson, Ltd., extend their greetings to their many friends all the world over, with all best wishes for prosperity in the New Year.

NALDER BROS. & THOMPSON, LTD..

34, Queen Street,
London, E.C.

Teleg.: "Occlude, London."
Telephones: 123 & 124, Bank.

THEY ALL POSSESS THE N.C.S. REPUTATION!

N.C.S. AMMETERS and VOLTMETERS.
Soft Iron Moving Coil and Dynamometer Patterns.

RECORDING INSTRUMENTS
(as supplied to the Admiralty).

The N.C.S. "OHMER" INSULATION TESTING SET.
Latest, Lightest, Cheapest and Best.

LEAKAGE INDICATORS.

NEW PORTABLE STANDARD INSTRUMENTS.
Ammeters, Voltmeters, or Wattmeters.

AUTOMATIC ACCUMULATOR CHARGING SWITCHES.

LIMITERS.

CIRCUIT BREAKERS.

DISPLAYED ADVERTISEMENTS.

ADVERTISERS will please note that **NEW COPY and ALTERATIONS** to **Existing Advertisements** (with Blocks) should reach here not later than **MONDAY MORNING.**

The ELECTRICAL REVIEW is the recognised Medium of the Electrical Trades, and has BY FAR THE LARGEST CIRCULATION of any Electrical Industrial Paper in Great Britain.

NOTICES RELATING TO PATENTS.

Latest time for receiving, 9.30 a.m. Thursday.

John E. Raworth,
Queen Anne's Chambers, 30, The Broadway, Westminster, S.W. Chartered Patent Agent.

S. SOKAL, Chartered Patent Agent and Certified Austrian Patent Attorney (Patentanwalt), 55, CHANCERY LANE, LONDON, W.C.

THE 'PATENTEE'S HANDBOOK.' By J. G. LORRAIN, M.I.E.E., M.I.Mech.E., CHARTERED PATENT AGENT. Gives full information and advice to intending Patentees. Sent post-free on application to Mr. J. G. LORRAIN, Norfolk House, Norfolk Street, Strand, London, W.C.

NOTES ON THE PATENTS AND DESIGNS ACT, 1907
By Messrs. LLOYD WISE & CO., Chartered Patent Agents.
Can be obtained from their Offices, 46, Lincoln's Inn Fields, London W.C. (Price 1s.).

THE OWNERS of Patents Nos. 1451/1908, relating to "Improvements in Submarine Signalling Apparatus"; 1848/1908, relating to "New or Improved Apparatus for Alternative Wireless Telegraphy and Telephony," and 14 775/1908, relating to "Improvements in Transmitting Apparatus for Submarine Signalling," are desirous of negotiating with interested parties for the granting of licenses under them on reasonable terms.

For information apply to
MESSRS. LLOYD, WISE & CO.,
Chartered Patent Agents and Consulting Engineers,
46, Lincoln's Inn Fields, London, W.C. 1169

OFFICIAL NOTICES.

Latest time for receiving, 9.30 a.m. Thursday.

COMMONWEALTH OF AUSTRALIA.

Postmaster-General's Department,
7th November, 1910.

TENDERS are invited up to 14th MARCH, 1911, for the Installation of Wireless Telegraphy at Thursday Island and Papua.

Tender Forms and Specifications may be obtained at the Commonwealth Office, London.

JOSIAH THOMAS,
Postmaster-General. 1237

COMMONWEALTH OF AUSTRALIA.

Postmaster-General's Department,
16th November, 1910.

TENDERS are invited up to 18th APRIL, 1911, for the supply of One Common Battery Switchboard to the Postmaster-General's Department in Western Australia.

Tender Forms and Specifications may be obtained at the Commonwealth Office, London.

JOSIAH THOMAS,
Postmaster-General. 1238

COMMONWEALTH OF AUSTRALIA.

Postmaster-General's Department,
8th November, 1910.

TENDERS are invited up to 7th MARCH, 1911, for the Supply of 11 Sections of a Branching Multiple Magneto Lamp-Signalling Switchboard to the Postmaster-General's Department in Victoria.

Tender Forms and Specifications may be obtained at the Commonwealth Office, London.

JOSIAH THOMAS,
Postmaster-General. 1155

COMMONWEALTH OF AUSTRALIA.

Postmaster-General's Department,
7th November, 1910.

TENDERS are invited up to the 7th FEBRUARY, 1911, for the supply of 250 Indicators, to the Postmaster-General's Department in Victoria.

Tender Forms and Specifications may be obtained at the Commonwealth Office, London.

JOSIAH THOMAS,
Postmaster-General. 1154

OFFICIAL NOTICES —*Continued.*

CITY OF COPENHAGEN.

Turbo-Dynamo, &c.

THE MUNICIPALITY OF COPENHAGEN require Tenders for the delivery of one 4,000-KW. Steam Turbine Generator with Condensing Plant.

Specifications and Conditions of Contract may be had on application to Elektrisk Station, Gothersgade No. 30, Kopenhagen K. on payment of 30 kr., which sum will be refunded on return of the Specification accompanied with the Tender.

Tenders must be sent to "Direktoren for Kobenhavns Belysningsvaesen, Raadhuset, Kobenhavn B.," not later than 12 o'clock noon, January 16th, 1911.

Kobenhavns Belysningsvaesen,
December, 1910. 1221

CITY OF BIRMINGHAM.

TRAMWAYS DEPARTMENT.

THE TRAMWAYS COMMITTEE are prepared to receive Tenders for the supply of Stores as set forth in the following Schedules during the year ending the 31st March, 1912:—

Schedule No.	1.—Glass.
,,	2.—Iron and Steel.
,,	3.—Leather and Rubber Goods.
,,	4.—Cotton Waste, White Rags, Sponges.
,,	5.—Paint, Varnishes, &c.
,,	6.—Springs.
,,	7.—Electrical Sundries.
,,	8.—Oils, Greases, &c.
,,	9.—Chemists' Sundries.
,,	10.—Iron and Steel Castings.
,,	11.—Malleable Iron Castings.
,,	12.—Insulating Materials.
,,	13.—Brushes (including Paint Brushes).
,,	14.—Files.
,,	15.—Ironmongery.
,,	16.—Bolts and Nuts, Washers, &c.

Conditions of Contract and Forms of Tender may be obtained on application to the undersigned on and after the 2nd January, 1911.

The Tender, filled up as directed, must be enclosed in a sealed cover, addressed to the Chairman of the Tramways Committee, and endorsed in the left-hand corner, and delivered to the Birmingham Corporation Tramway Offices, 147, Corporation Street, Birmingham, not later than 12 o'clock noon, on MONDAY, the 30th day of JANUARY, 1911.

ALFRED BAKER,
General Manager. 1277

HASLINGDEN UNION.

Electric Lighting of Workhouse and New Infirmary.

THE GUARDIANS of the Poor of the Haslingden Union invite Tenders for the installation of the necessary equipment for the Electric Lighting of their Workhouse and New Infirmary at Higher Pike Law, Rawtenstall.

The Specification, Form of Tender and permission to inspect the Plans and Drawings, may be obtained on application to the undersigned; a deposit of two guineas (to be returned on receipt of a *bona fide* tender), must accompany such application.

The plans, &c., may be subsequently inspected at the office of the Consulting Engineer, Mr. C. D. COPELAND, M.I.E.E., 16, John Dalton Street, Manchester.

The Guardians do not bind themselves to accept the lowest or any tender; moreover, the tender will be accepted provisionally in the first place, subject to the subsequent confirmation (if necessary) of the Local Government Board, and to the entering into a Contract Agreement under Seal.

Sealed Tenders endorsed "Electric Installation," must reach me on or before TUESDAY, 10th JANUARY, 1911.

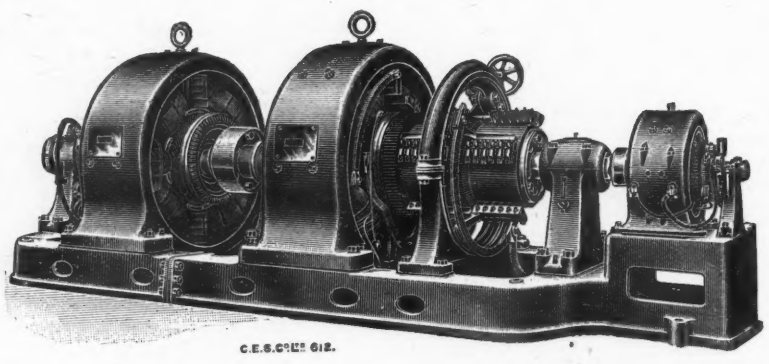
By order,
J. H. SINKINSON,
Clerk to the Guardians.

Union Offices, Rawtenstall,
22nd December, 1910. 1276

(*Continued on page* 21).

THE

ENTZ BOOSTER



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LONDON OFFICE: 39, VICTORIA STREET.

OFFICIAL NOTICES.—*Continued from page* 19.

BOROUGH OF TODMORDEN.

TENDERS are invited for the Wiring, Supply and Fixing of Fittings for the whole of the interior offices, &c., of the Town Hall, including conversion of existing gas chandeliers in the Public Hall.

Specification and all information may be obtained upon personal application at my office, where plans may also be seen.

Tenders, endorsed "Lighting of Town Hall," to be sent into the undersigned on or before 9 a.m. JANUARY 11th, 1911.

The Town Council do not bind themselves to accept the lowest or any tender.

HENRY TALBOT,
Borough Electrical Engineer. 1258

COUNTY BOROUGH OF WARRINGTON.

ELECTRICITY DEPARTMENT.

THE ELECTRICITY AND TRAMWAYS COMMITTEE of the County Borough of Warrington are prepared to receive Tenders for E.H.T. Cable.

Specification and Form of Tender can be obtained from the undersigned on payment of one guinea, which will be returned on receipt of a *bona fide* tender. Five shillings will be charged for extra copies of specifications.

Tenders, addressed to the "Chairman of the Electricity and Tramways Committee," Town Hall, Warrington, must be sealed with wax and endorsed "Tender for E.H.T. Cable," and delivered not later than 12 o'clock noon, on TUESDAY, JANUARY 10th, 1911.

The lowest or any tender will not necessarily be accepted.

F. V. L. MATHIAS,
Borough Electrical and Tramways Engineer.
Howley, Warrington. 1282

MUNICIPAL COUNCIL OF SHANGHAI.

THE COUNCIL invite Tenders for the Supply and Delivery c.i.f. Shanghai, of the following:—

CONTRACT No 4.—Main High-tension Switchboard and auxiliary Switchgear for Generating Station.

CONTRACT No. 5.—Static Transformers.

CONTRACT No. 6.—High and Low Tension Switchgear for sub-station.

Specifications, General Conditions and Forms of Tender may be obtained from Messrs. PREECE, CARDEW AND SNELL, 8, Queen Anne's Gate, Westminster, S.W., on payment of a deposit of £1 for each contract, which will be refunded on receipt of a *bona fide* tender.

Extra copies of each specification can be obtained on payment of 2s. 6d. each, non-returnable.

Sealed tenders, in duplicate, endorsed "Shanghai" are to be delivered to Messrs. PREECE, CARDEW AND SNELL, 8, Queen Anne's Gate, Westminster, S.W., before 12 o'clock noon, on WEDNESDAY, JANUARY 18th, 1911.

The Council do not undertake to accept the lowest or any tender, and reserves the right to accept the whole or portion of any tender. 1327

OFFICIAL NOTICES.—*Continued.*

ALDERSHOT URBAN DISTRICT COUNCIL.

COAL SUPPLY.

TENDERS are invited by the above-named Council for the supply, during the next twelve months, of 750 tons of Steam Coals. The Coal is to be one of the following: Baddesley Beans, Kingsbury Beans, Griff Peas, or Arley Peas. Full particulars can be obtained on application to the Electrical Engineer, Electricity Works, Laburnum Road, Aldershot.

Tenders, endorsed on envelope "Coal," are to be in the hands of the undersigned, not later than 10 a.m. on TUESDAY, 17th JANUARY, 1911. The accepted Tender will be subject to usual contract and bond, but the Council do not bind themselves to accept the lowest or any Tender.

W. E. FOSTER,
Clerk of the Council.

Municipal Buildings,
Aldershot,
December, 1910. 1328

TENDERS are invited for supply and delivery at Electricity Works, Copse Road, Fleetwood, of 1300 yards of ·075 × ·075 × ·037, and 800 yards of ·15 × ·15 × ·075 Triple Concentric Paper-insulated Lead-covered Double Steel Tape Armoured L.T. Cables.—Full particulars, and earliest delivery time, to be sent not later than 3rd JANUARY to W. H. MILLER, Engineer and Manager. 1302

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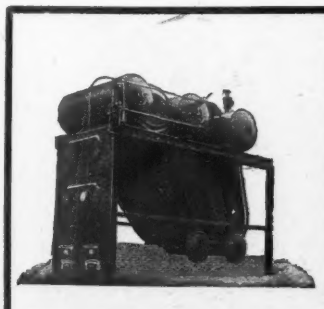

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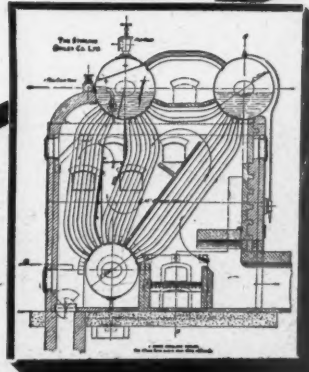

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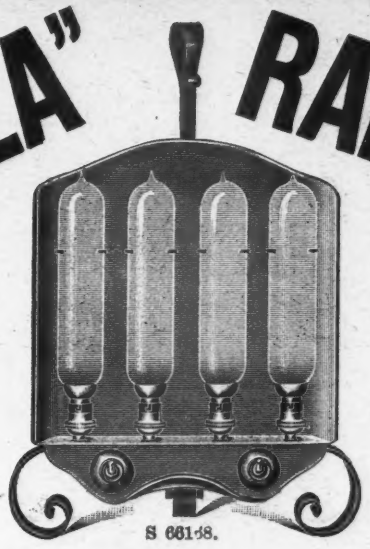

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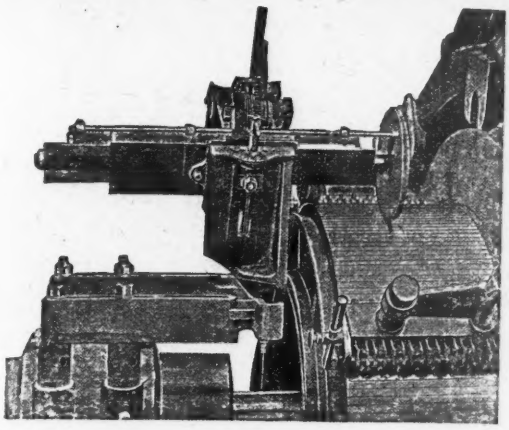

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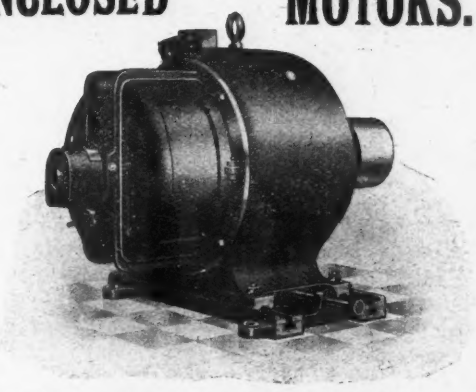

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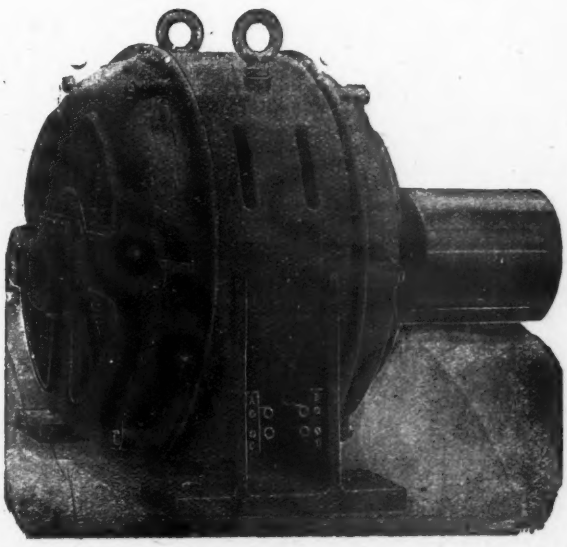

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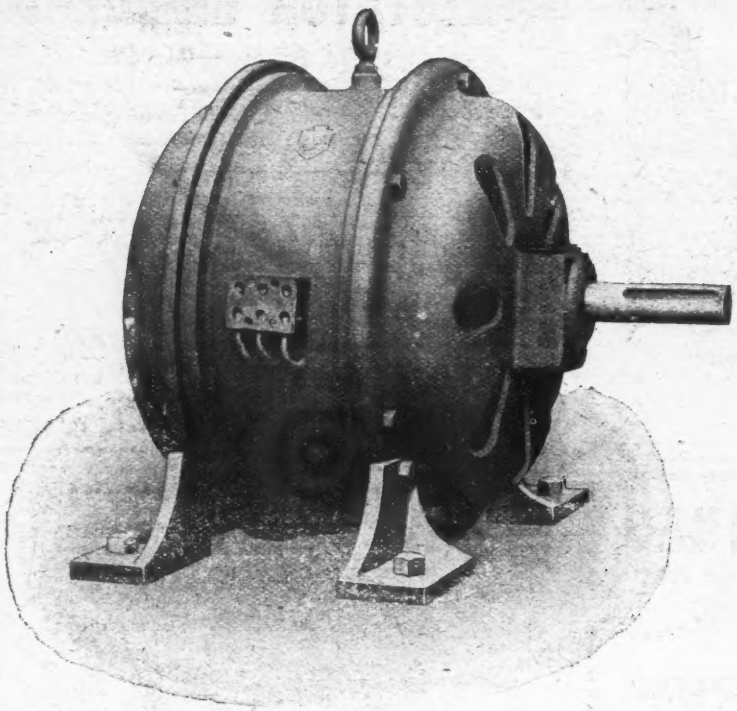

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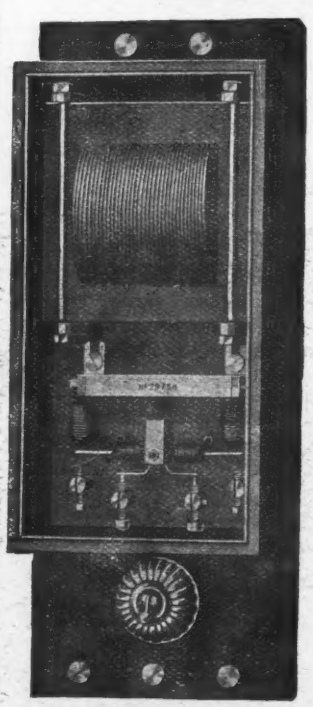

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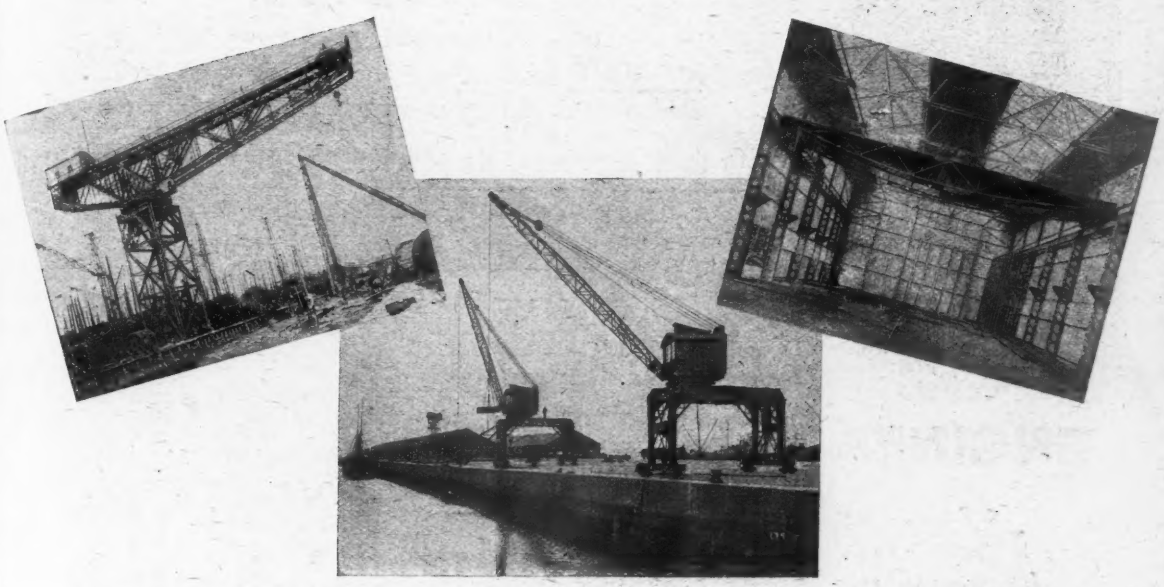

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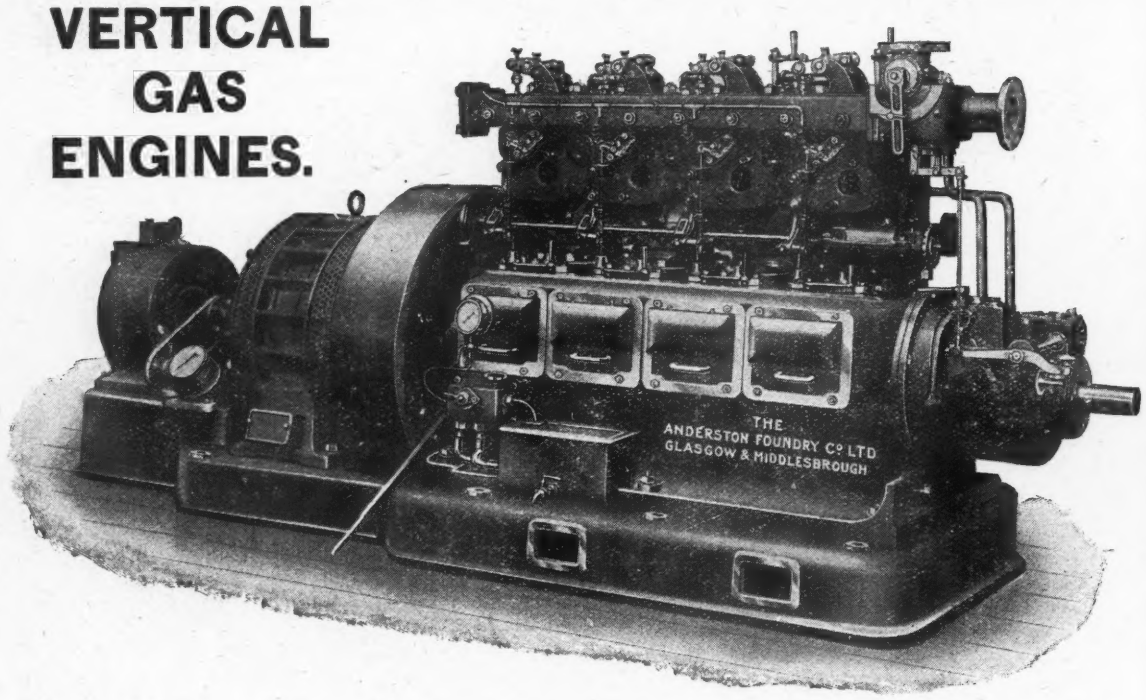

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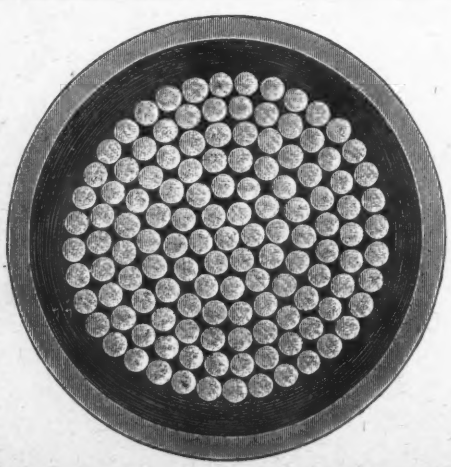

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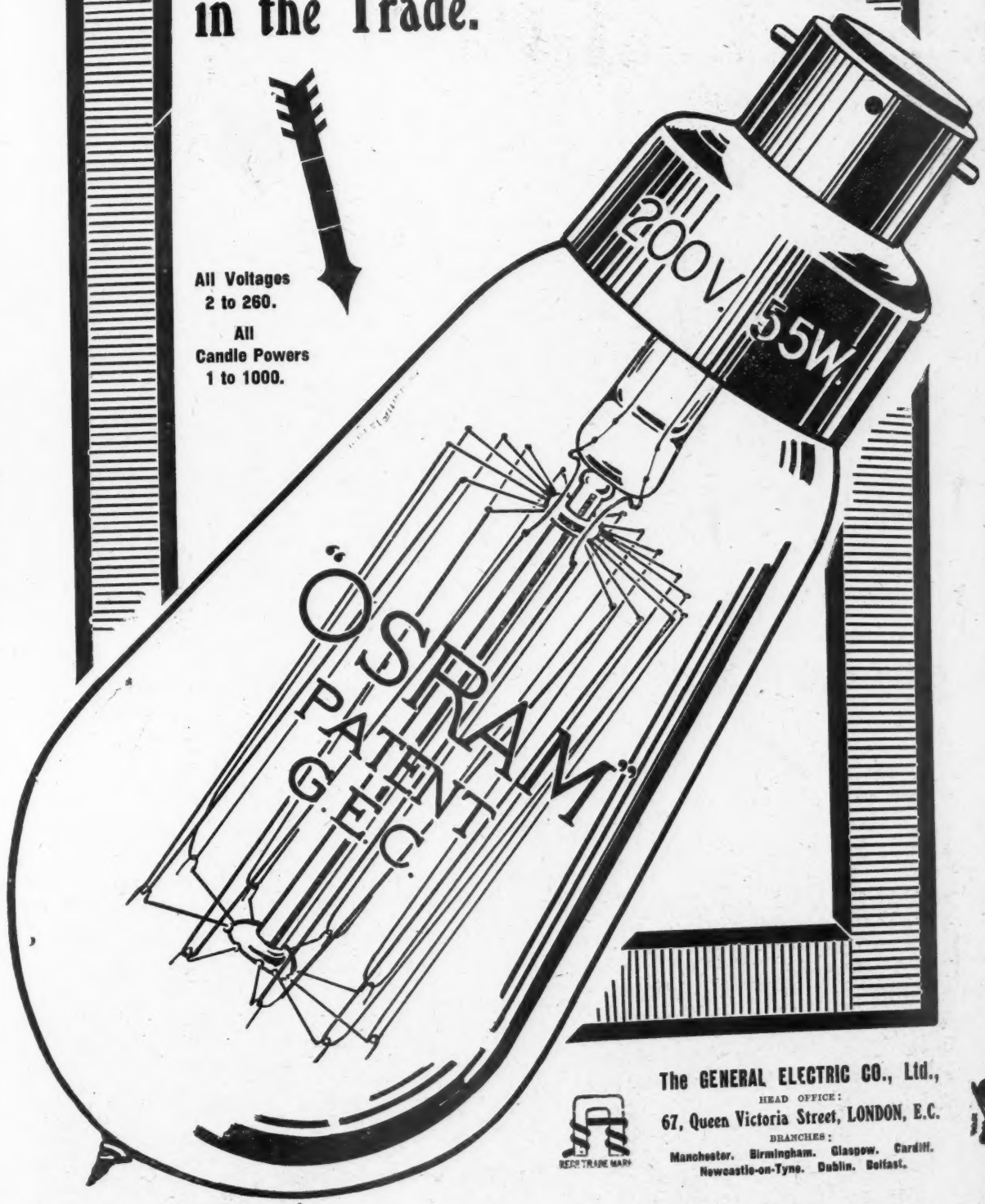

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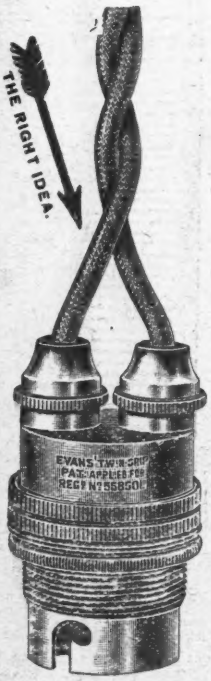

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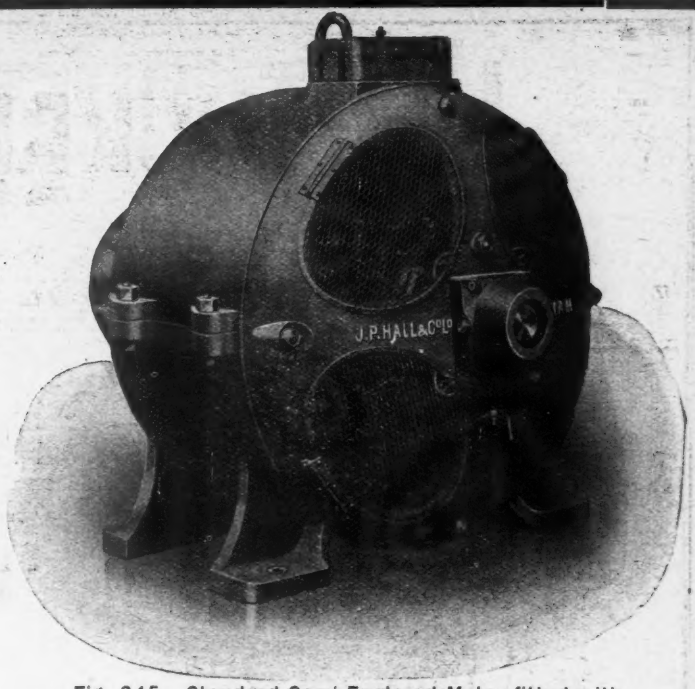

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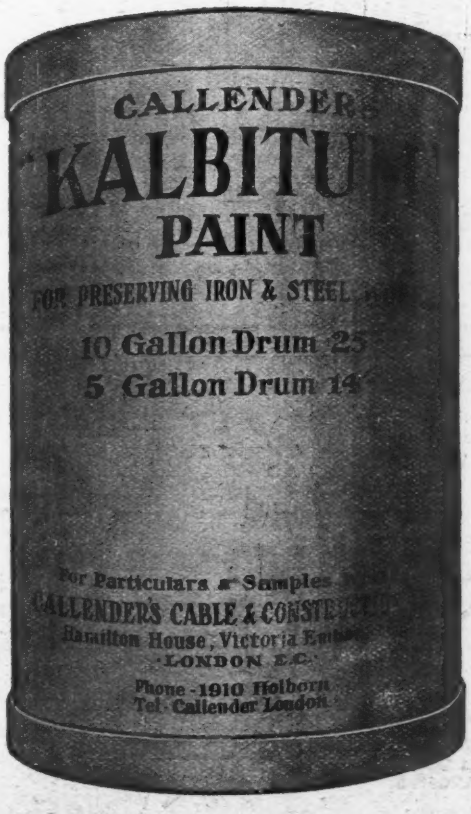

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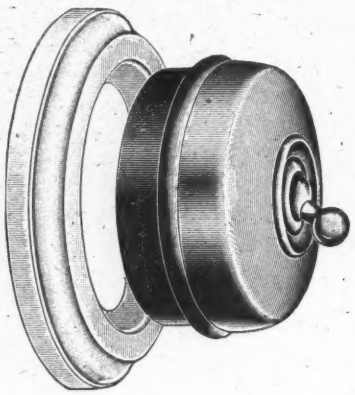

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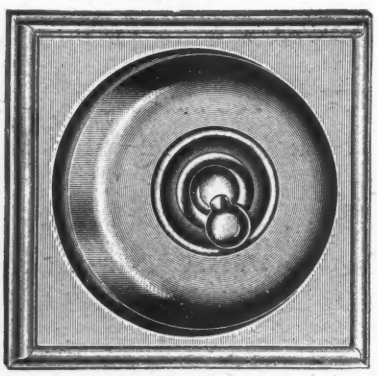

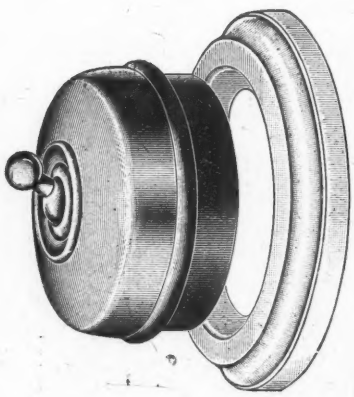

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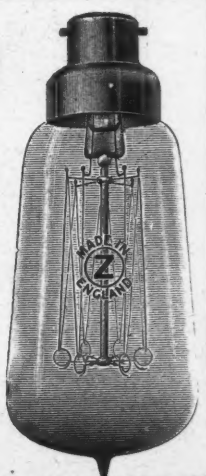

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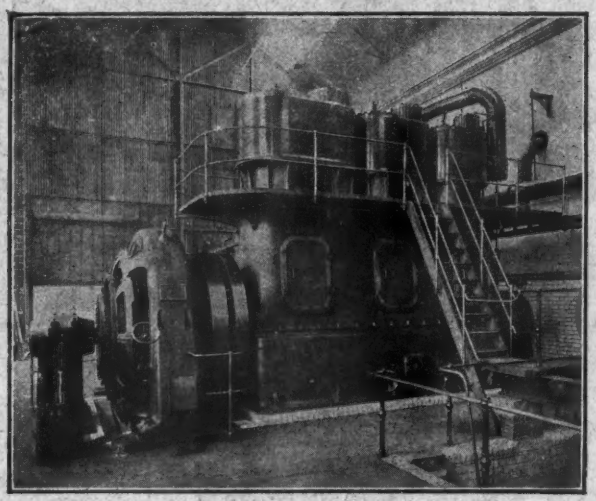

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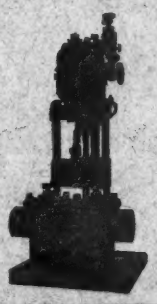

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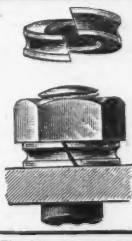

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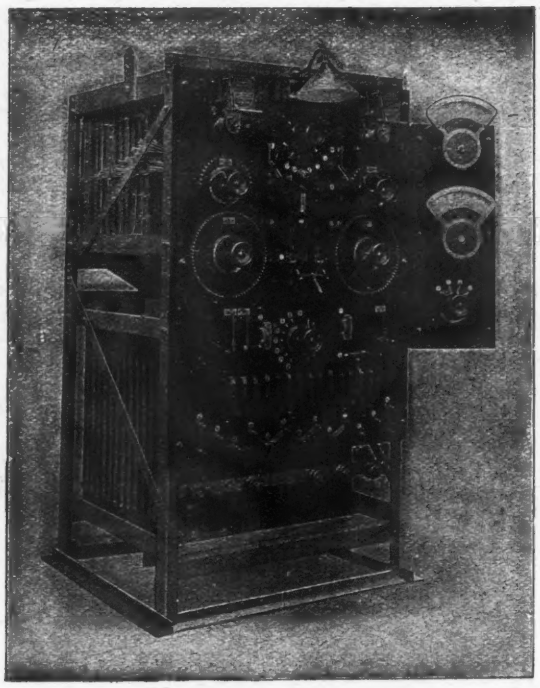

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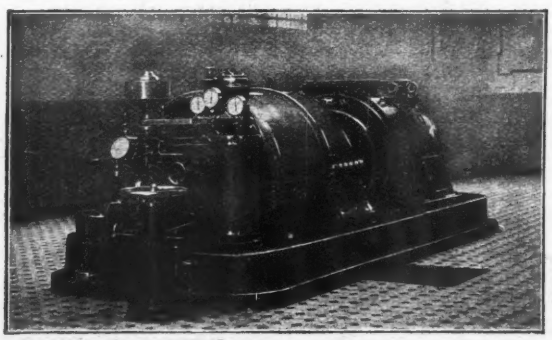

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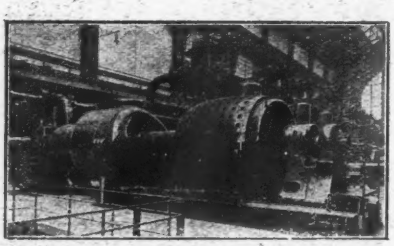

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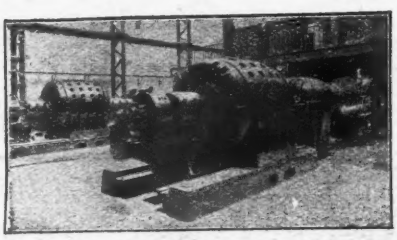

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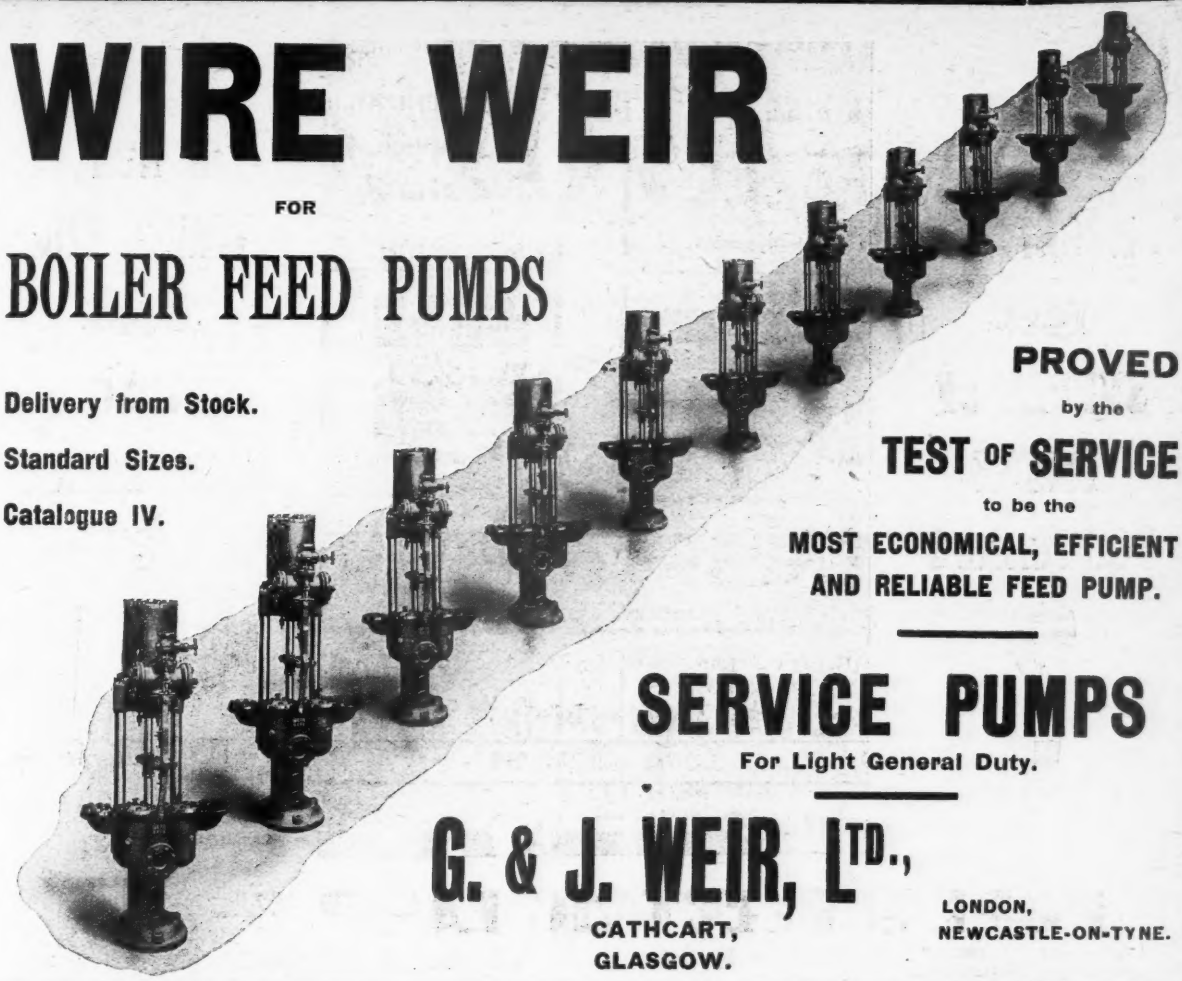

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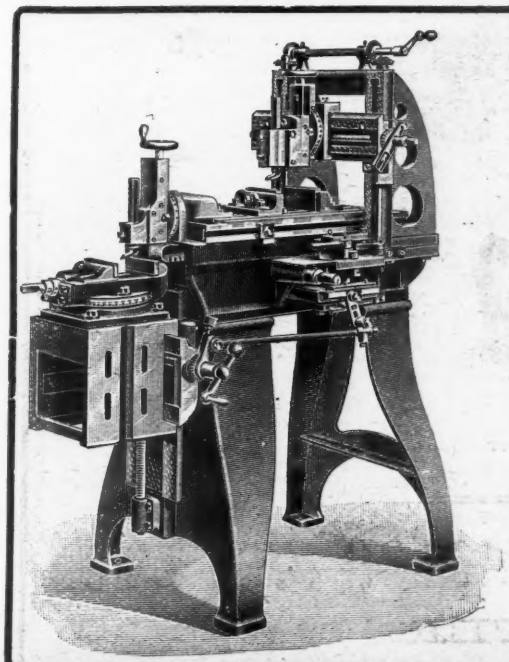

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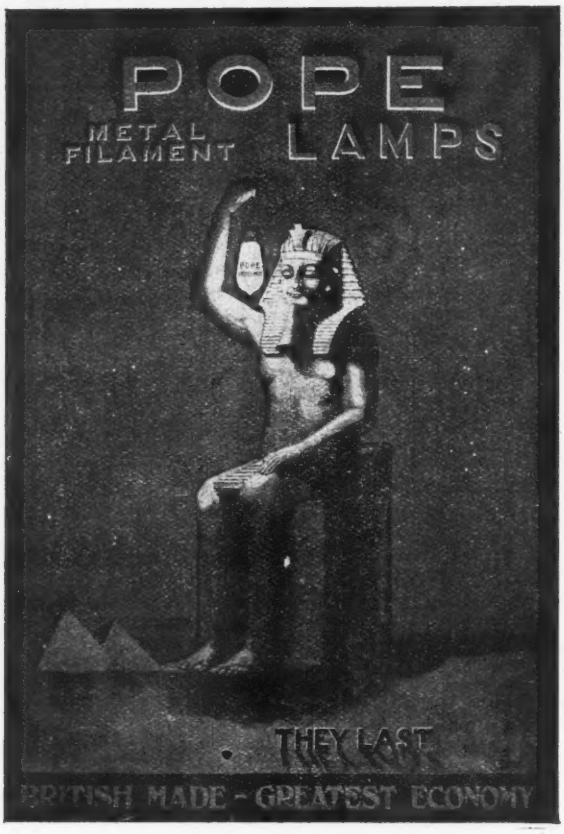

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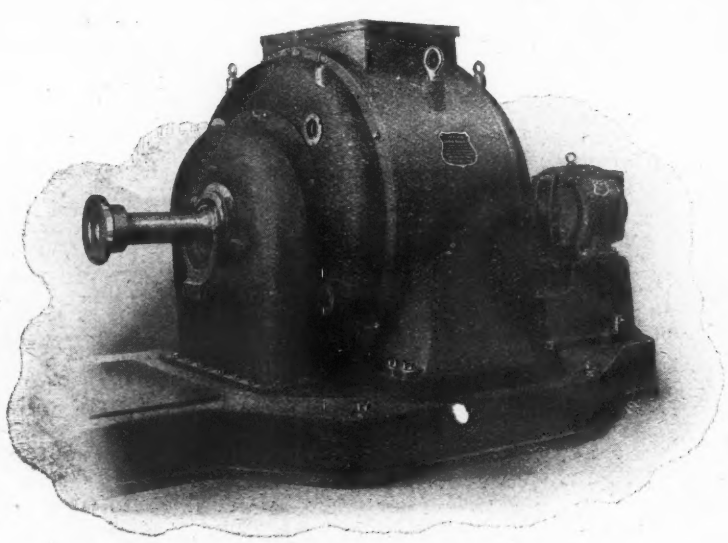

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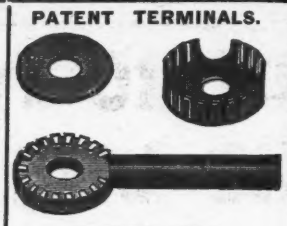

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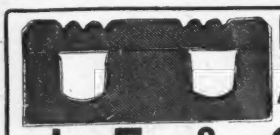

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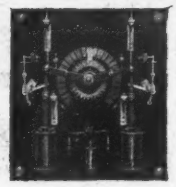

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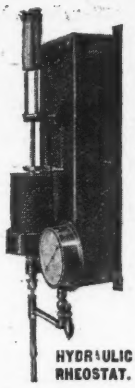

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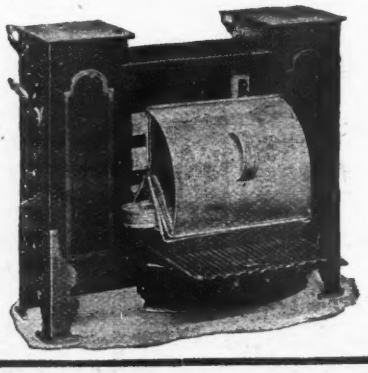

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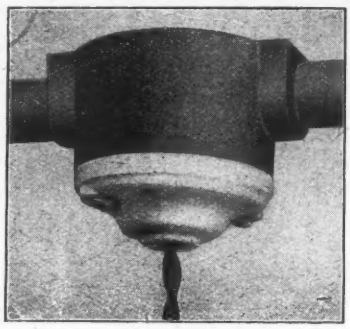

NEW LIST No. 95 PAGE 147.

ALL

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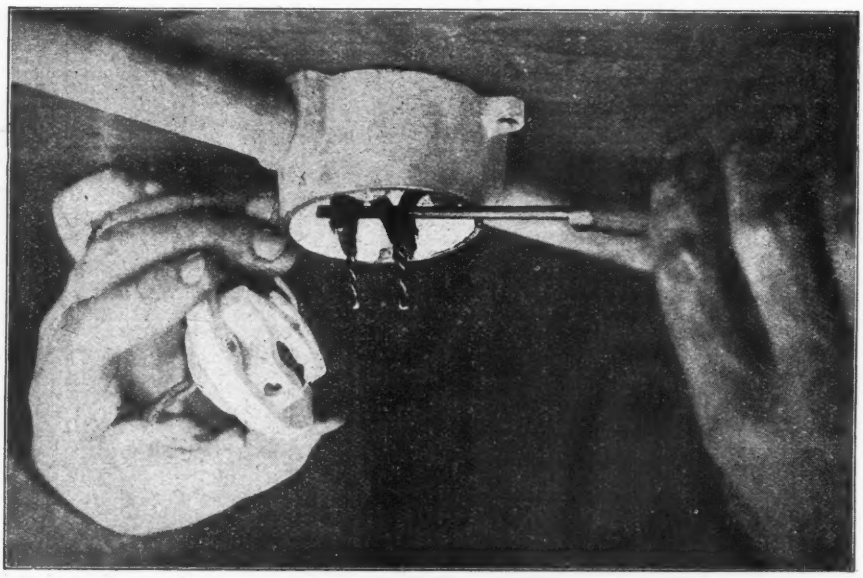
USE THE D. & S. No. 227 PATENT CEILING PLATE,



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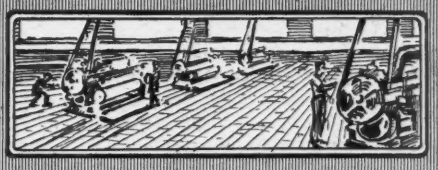

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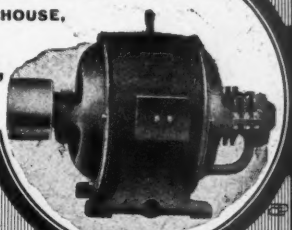

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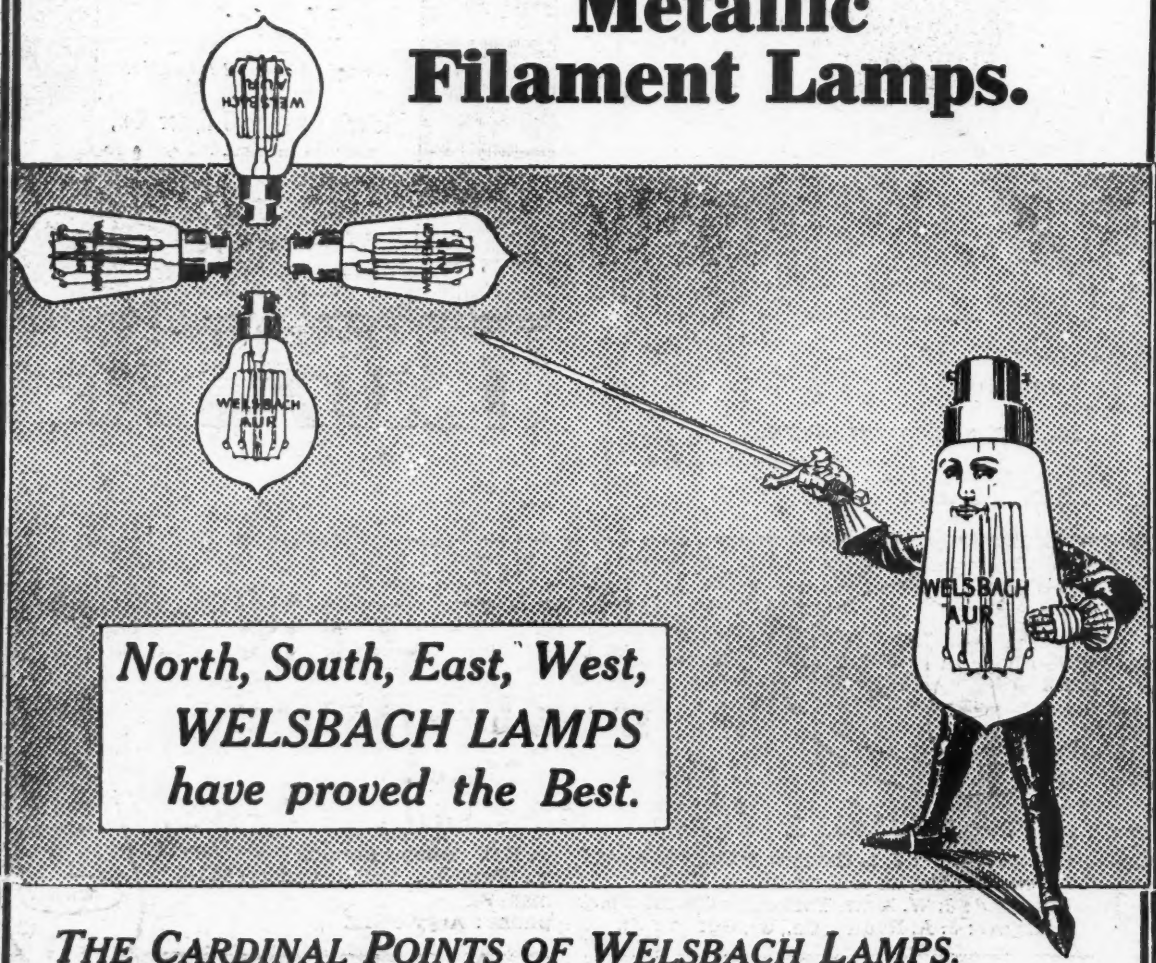

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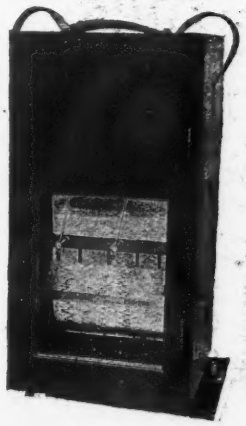

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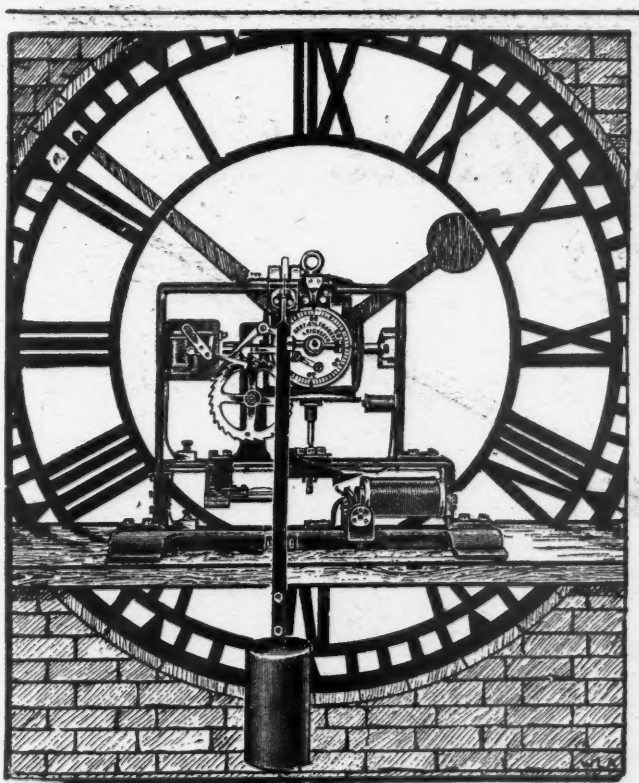

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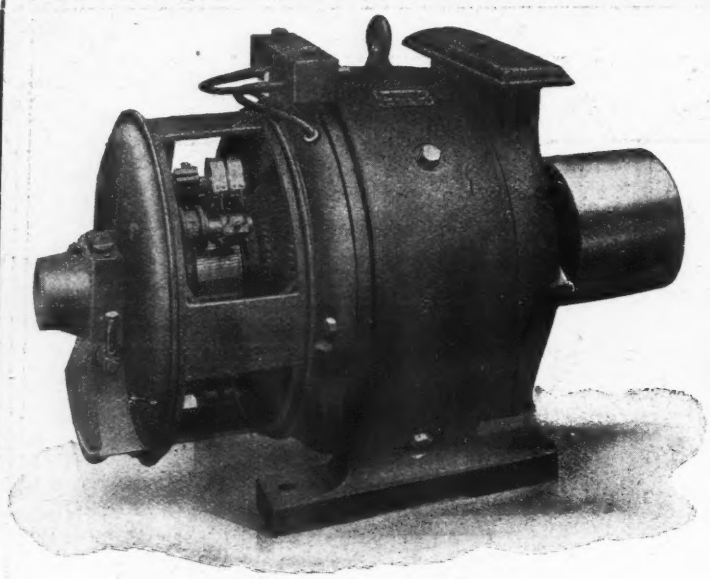

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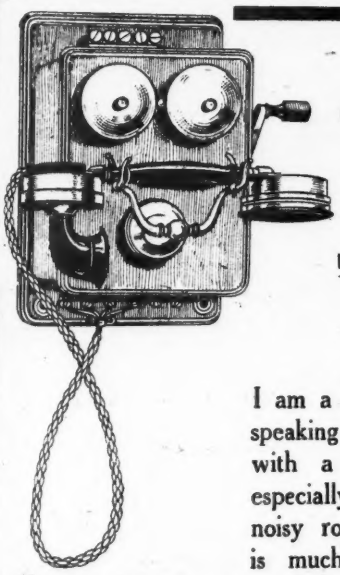

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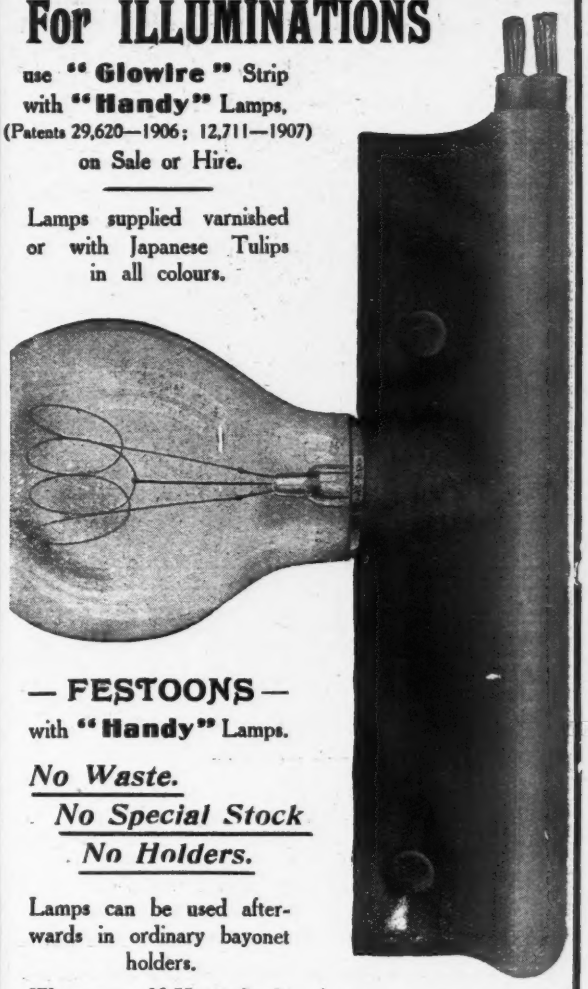

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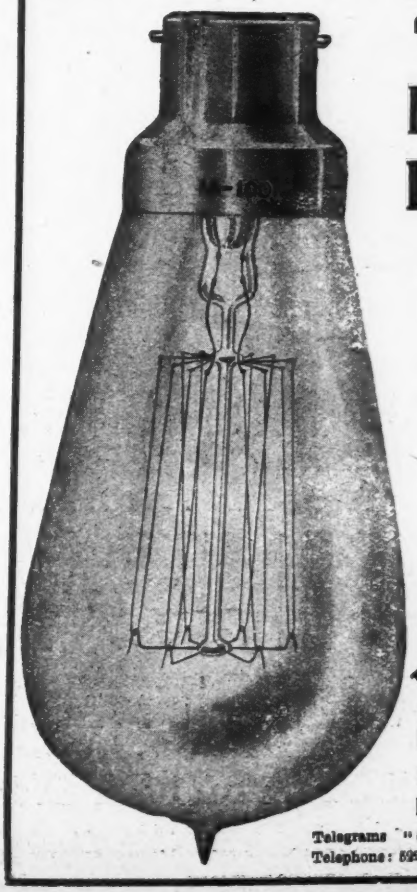

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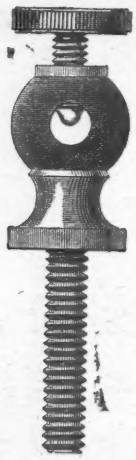

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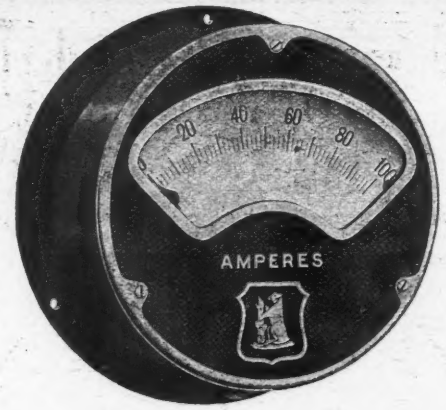

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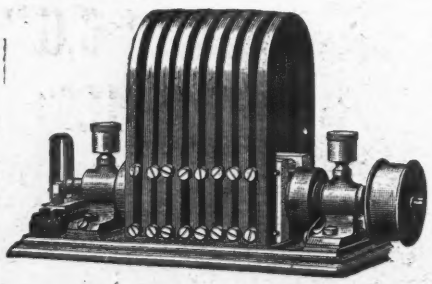

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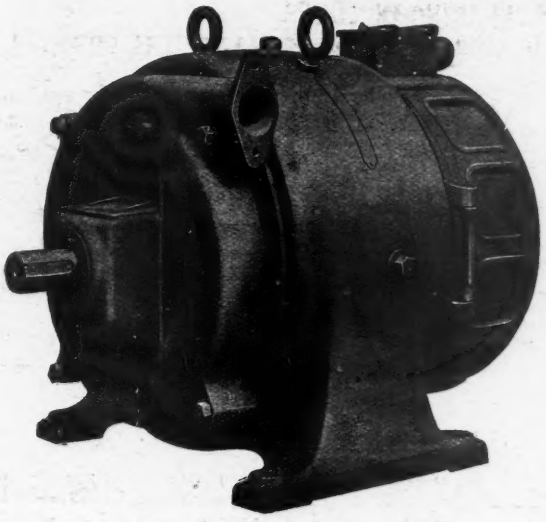

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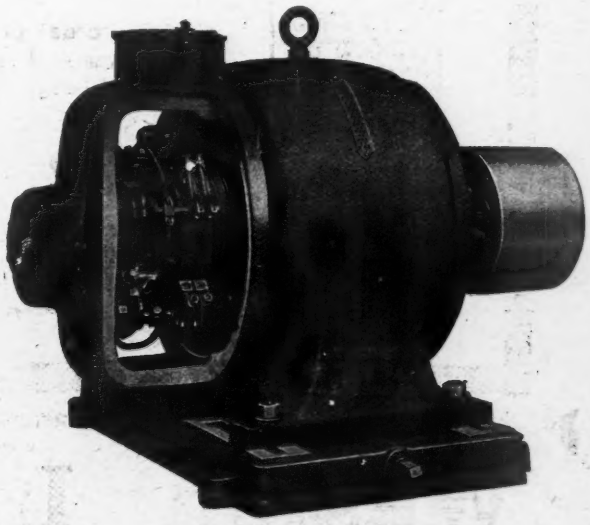

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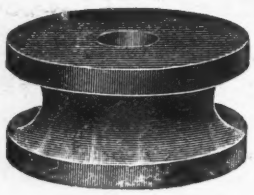

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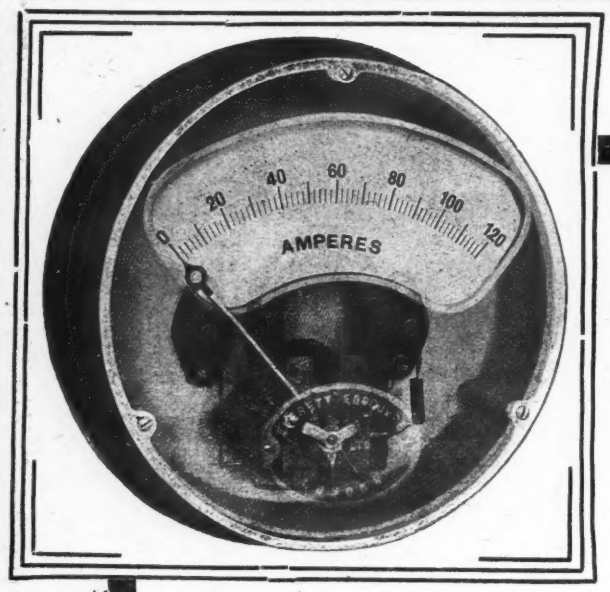

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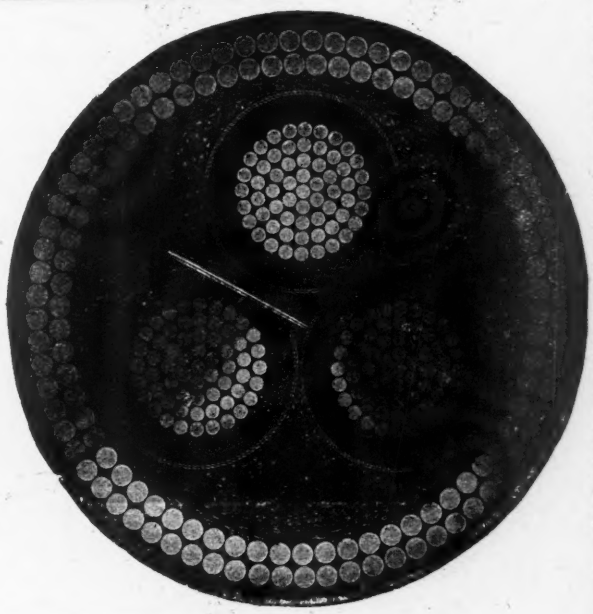

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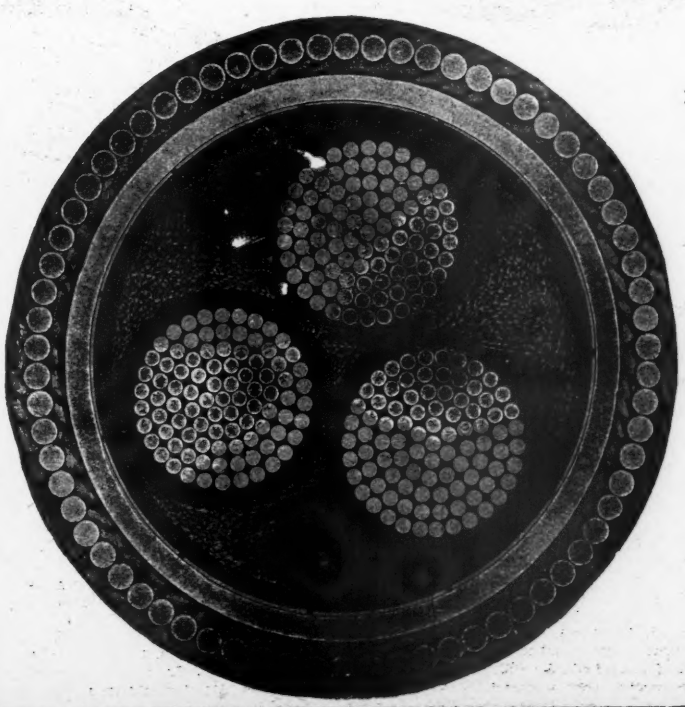

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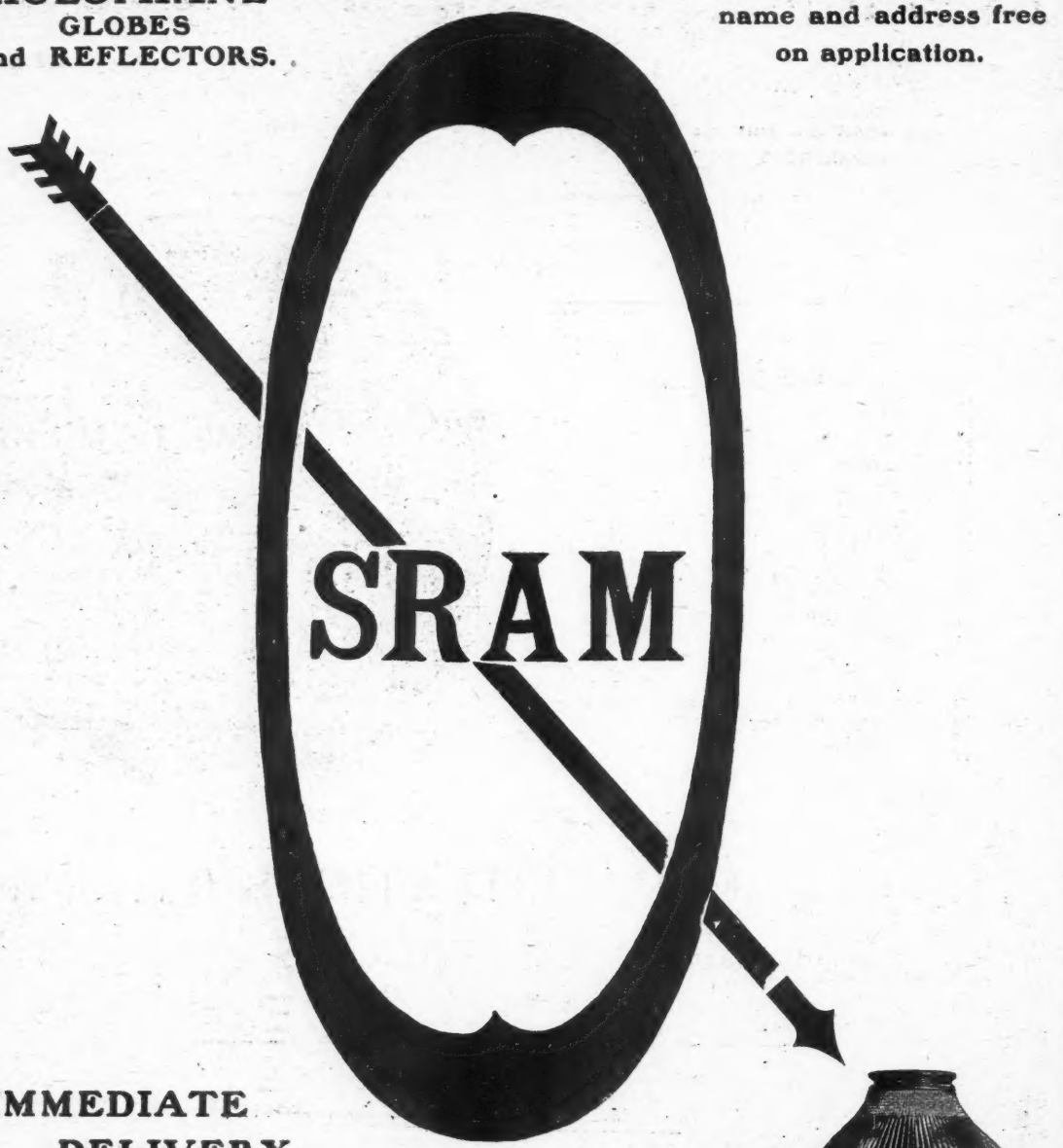

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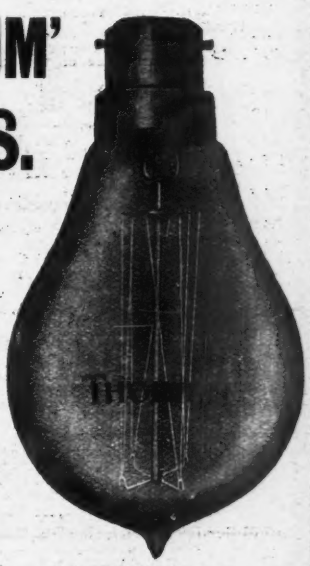

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CONTRACTORS' COLUMN.

[The following information is published in the interests of electrical contractors and others who are seeking for openings for new business. Considerable expense is incurred in the production of this column, and every care is taken to ensure that the information is new and accurate, but it will be understood that in a matter where so many correspondents are engaged, and where the amount of information to be handled is very large, this cannot always be guaranteed. If alleged inaccuracies are reported to the Editors, they will be fully investigated.]

ABERDARE.—Two pairs of cottage homes at Lwydcoed, for the Merthyr B.G.; T. Roderick, architect, Clifton Street, Aberdare. Alterations, &c., to Tabernacle Congregational Church and school, Duke Street; J. Ll. Smith, architect, Aberdare.

ACKWORTH.—Gymnasium and science block at school; J. Stuart, County Hall, Wakefield.

ADWICK-LE-STREET (near DONCASTER).—New school, for the West Riding of Yorks. C.C. (£4,200); Education Architect, County Hall, Wakefield.

ATHERTON (near MANCHESTER).—Blocks of houses; Surveyor, Council Offices, Atherton.

BARNSLEY.—New carriage works, Town End, for Rev. T. T. Taylor. Electric theatre, Eastgate, for the London and General Electric Theatres, Ltd. Additions to Zion Church, Cutty Lane, Old Town, for the Trustees. Conversion of warehouse, Queen's Road, into cinematograph hall, for the Barnsley Picture Palace Co.

BARTON-ON-HUMBER.—New Wesleyan Methodist Sunday schools, South Ferriby (£625).

BEDDINGTON.—New schools, Bandon Hill; Secretary, Surrey Education Committee, Kingston.

BELFAST.—Variety theatre (£10,000); Swanston & Syme, architects, Redburn Wynd, Kirkcaldy.

BEDWAS (CARDIFF).—School (650 places); School Managers.

BEXHILL.—Parish hall, Little Common; Mr. Gillham, builder, Little Common. Bottling store in Endwell Road; G. H. Gray, architect, Bea Road, Bexhill. Proposed King Edward Memorial Hospital; Mayor of Bexhill.

BIRKENHEAD.—Rebuilding engineering works (after fire), for A. Rutherford and Co. (damage £2[illegible],000).

BLAENAVON (near PONTYPOOL).—Probable re-erection (after fire) of joinery works, Cwmavon Road, for J. Morgan (damage £1,[illegible]00).

BOURNEMOUTH.—Alterations, &c., to Brading, Stafford Road, for the T.C.; F. W. Lacey, Borough Engineer.

BRADFORD.—New Wesleyan Methodist Mission Hall, corner of Cliffe and Bolton Roads; H. W. Long, architect, Fairmeade, Calverley, near Leeds.

BREDBURY (near STOCKPORT).—Extensions to Britannia Engineering Works.

BROMLEY (KENT).—Extension of the post office, for H.M. Office of Works, Postmaster, Bromley.

BUCKIE.—New manse, for the Parish Church.

BURNHAM.—New parish hall; W. H. Chowins, architect.

CAMBRIDGE.—Alterations and additions, Ancient Druid Inn, Fitzroy Street (£320); T. Cockrill, architect, 8, Bank Buildings, Bedford; H. Rooke, builder, Cambridge.

CARDIFF.—Theatre (to seat about 900) and skating rink, City Road, for the Gaiety (Cardiff) Electric Theatre and Rink Co., Ltd.; H. P. Sanders, architect, Cardiff. Extension of Tredegar Hotel; S. Williams, architect, Wharton Street, Cardiff. Rebuilding Presbyterian Church, Windsor Place; E. M. B. Vaughan, architect, Cardiff.

CARLIN HOW (near LOFTUS).—New Wesleyan Methodist Church.

CARLTON.—Branch premises, Gedling Street (£930); W. H. Woods, architect, High Street, Long Eaton, near Nottingham; Mr. Loach, builder, Station Road, Carlton.

CHESTER.—New station sorting office, for H.M. Office of Works; Postmaster, Head Post Office, Chester.

CLYDEBANK.—Addition to sawmill, for the Singer Manufacturing Co.

COVENTRY.—Territorial headquarters, for the Warwickshire Territorial Force Association; J. H. Liddington, architect, Rugby. Public mortuary, rear of the Central Fire Station (£2,150); City Engineer.

DARLINGTON.—Re-construction of premises, Printing House Square, for W. E. Dove & Co., Ltd., and others; Hoskins & Brown, architects Court Chambers, Darlington.

DEWSBURY.—Residence, Savile Road, Savile Town; Barton & Son, architects, Halifax Road, Dewsbury.

DOWNPATRICK.—Manse for Ballee Unitarian Church; Hobart & Heron, architects, Belfast.

DROYLSDEN.—Proposed new Conservative Club premises.

DURHAM.—School, near Philadelphia (£5,000); W. Rushworth, architect, Shire Hall, Durham.

EDINBURGH.—Buildings, Upper Grey Street, for the Sisters of Charity (£1,800); A. McPherson, 7, Young Street, Edinburgh.

ERITH (KENT).—New Wesleyan Methodist Sunday School.

ESSINGTON (near WOLVERHAMPTON).—New schools for Staffs. C.C. (£1,437); T. Mason & Son, builders, Hednesford.

FRINTON-ON-SEA.—Addition to residence, "Eastry," Third Avenue, for S. A. Courtauld.

GALLATOWN (near KIRKCALDY).—School (£8,000); W. F. Smith, architect, 210, High Street, Kirkcaldy.

GLASGOW.—Savoy Theatre (£24,000); J. Millar, architect, 15, Blythswood Square, Glasgow. Administrative buildings (£99,000); A. B. McDonald, city engineer, George Street, Glasgow. Extension of Barr & Stroud's premises, Anniesland (£10,000); G. Thomson, architect, 164, Bath Street, Glasgow. Additions to premises for the Albion Motor Co., Ltd. (£3,000); Brand & Lithgow, 131, West Regent Street, Glasgow.

GLOUCESTER.—Tramp ward, for the B.G. (about £1,200).

GOOLE.—New school, for the West Riding of Yorks. C.C. (£4,200); Education Architect, County Hall, Wakefield.

GORLESTON-ON-SEA.—New buildings for the East Anglian Institution for Blind and Deaf Children; J. E. Burton, architect, 57, London Street, Norwich.

GRAYS (ESSEX).—Structural alterations at "Whitehall," Whitehall Lane, for the Whitechapel Guardians; C. M. Shiner, architect, The Gate House, Grays.

GREAT YARMOUTH.—Probable re-erection, after fire, of business premises, Southgate Road, for Sussam's, Ltd., bakers and grocers.

GREENMOUNT (Co. ANTRIM).—Conversion of buildings into school of agriculture, for the C.C.

GUISBOROUGH.—Extensive alterations and additions to grammar school, for North Riding of Yorks. C.C.

HAMILTON (N.B.).—School, Hope Street (£10,000), and extension to Beckford Street School (£3,000); G. Paterson, architect, 4, Cadznow Street, Hamilton.

HARROGATE.—Additions to hotel, Cold Bath Road, for the Beechwood Hotel Co., Ltd. Alterations to Friendly Societies' Hall, Mount Parade; W. H. Midgley, architect. Alterations to business premises, Parliament Street, for C. E. Taylor & Co.

HAYES (MIDDLESEX).—Lodge, Printing House Lane (£850); Hayward and Maynard, architects, 14, John Street, Adelphi, W.C.

HELENSBURGH.—Extensions to church (£2,150); A. N. Paterson, architect, 266, St. Vincent Street, Glasgow.

HERTFORD.—Alterations and additions to envelope factory and printing works, for Simson & Co., Ltd.; H. Norris & Son, builders, Priory Works, Hertford.

HIGH WYCOMBE.—Alterations and additions to Girls' High School, for Bucks. C.C. (£2,000); C. H. Riley, County Architect, County Hall, Aylesbury.

HUDDERSFIELD.—New post office, for H.M. Office of Works.

HUNSLET (near LEEDS).—New moulding shop, for Catton & Co., Ltd.; Myers-Beswick & Partners, engineers, 8, Park Square, Leeds.

HYDE.—Alterations to 60, Market Street, for Boots, Ltd. Additions to laundry, Swain Street, for Hyde Steam Laundry. Proposed extension of baths; Borough Surveyor, Town Hall.

KIRKINTILLOCH.—Hall, St. David's U.F. Church (£1,400); W. Baillie, architect, 2, West Regent Street, Glasgow.

KING'S NORTON (near BIRMINGHAM).—New schools, Woodgate, for the U.D.C.; Crouch, Butler & Savage, architects, Birmingham.

JOPPA, N.B.—Extensions to granary (£3,000); N.B. Railway Co., Edinburgh.

LEEDS.—Alterations to Kirkstall Library (£400). Sanatorium for Consumptives, at Dacre Banks (£16,000); West Riding C.C., County Hall, Wakefield.

LIMEHURST (near ASHTON-UNDER-LYNE).—Additions to works, for the Medlock Vale Bleach Works Co.

LINTHORPE (near MIDDLESBROUGH).—Proposed parochial hall, school premises, &c., for St. Barnabas Church (about £1,000); Rev. J. W. Dales, Vicar.

LONDON (E.).—Structural repairs to 403-9, Mile End Road; Clerk to the Whitechapel Guardians, 74, Vallance Road, N.E.

(POPLAR, E.).—New branch post office, for H.M. Office of Works; J. Rutherford, architect, 22, Carlisle Place, S.W.

(WEST HAM, E.).—Proposed school near Beckton Road Recreation Ground; Secretary, West Ham Education Committee.

(PECKHAM, S.E.).—Cinematograph theatre, Rye Lane: Gilbert & Constanduros, architects, 43, Finsbury Square, E.C.

(S.E.).—Re-erection of 165-7, New Kent Road; S. A. S. Yeo, architect, 41, Finsbury Pavement, E.C.

(SOUTHWARK, S.E.).—Buildings, Tisdale Place; R. J. Dickins, surveyor, 155, Old Kent Road, S.E.

(TOTTENHAM, N.).—Development of the West Green Nursery Estate, Philip Lane and West Green Road; H. S. Couchman, architect, 520, High Road, Tottenham.

(S.W.).—Rebuilding 25-35, Hans Road, for Harrods Stores, Ltd.; C. W. Stephens, architect, 43, Hans Road, S.W.

(BARNES, S.W.).—Additions to the brewery; Watney, Combe, Reid and Co., Mortlake.

(FULHAM, S.W.).—Proposed church in Kelvedon Road; C. G. F. Rees, Stanmore, Middlesex.

LUTON.—Furniture warehouse, Castle Street, for Blundell Bros., drapers.

MAIDSTONE.—Probable re-erection (after fire) of business premises (lit by electricity), for Denniss, Paine & Co., drapers, &c., High Street.

MALTON (YORKS.).—New schools at Norton (520 places); Building Surveyor, County Hall, Beverley.

MANCHESTER.—New school in Atherton Street, Deansgate (£9,500); Secretary, Education Committee, Education Offices, Deansgate.

MANSFIELD.—New billiard room, West Hill House, for A. F. Houfton. Workshop, offices, &c., Walkden Street, and twenty houses, Recreation Street, for J. Beckett.

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MILNROW (near ROCHDALE).—Pumping station at Butterworth Hall, for the Oldham Corporation; C. J. Batley, engineer, Piethorn, New Hey near Rochdale.

MILTON (near STOKE-ON-TRENT).—New school (666 places), with cookery centre, for Staffs. C.C.; County Architect, Stafford. New Council school at Baddeley Green, near Milton (308 places); G. Balfour, Director of Education, County Education Offices, Stafford.

MITCHAM.—Additions to church, Beddington Corner; Rev. H. G. Dodd, Beddington Corner.

MORECAMBE.—Contemplated enlargements and alterations at Tower premises, to include new cinematograph theatre, conversion of present ballroom into music hall and theatre, provision of new ballroom, balcony, &c.; Secretary, Morecambe Tower and Estates Co., Ltd.

MOUSWALD (DUMFRIES-SHIRE).—Extensions to public school (£2,000); F. Adamson, architect, Collin, Dumfries-shire.

NEWCASTLE.—Lodging house (£5,000); P. L. Brown, 4, Northumberland Street, Newcastle.

NEWCASTLE-UNDER-LYME.—Alterations and additions to the Endowed Middle Schools, for the Managers (£5,455).

NEW FERRY (CHESHIRE).—Alterations at the C.E. Schools; the Managers.

PENDLEBURY.—Refuse destructor and other buildings, for the Swinton and Pendlebury U.D.C.

PORTSMOUTH.—New Congregational Church, Victoria Road, Southsea.

PUDSEY (YORKS.).—New Sunday Schools and Institute, for the United Methodist Church; W. H. Dinsley, architect, Chorley.

RAWTENSTALL.—Additions to St. John's School, Cloughfold; Managers. Alterations and additions to St. Anne's School, Edgeside; Managers.

RETFORD.—Girls' secondary school (£9,410), for Notts. C.C.

RICHMOND.—Additions to Richmond Hill School; W. J. & A. Long, 8, Friars Stile Road, Richmond.

ROCHDALE.—Pending alterations to premises, The Butts, for the London, City and Midland Bank, Ltd.

ROTHERHAM.—Warehouse and shop premises, Wortley Road and Park Street, for Geo. Cartledge. Offices and stores, off Bridgegate, for F. W. Crookes, printer, &c.

ROYTON (near OLDHAM).—Proposed alterations at St. Paul's School; Managers.

ST. HELENS.—Picturedrome, Bridge Street, for Wm. Ellis.

SCARBOROUGH.—New music hall, North Marine Road, for C. Cardow, amusement caterer, Scarborough. Buildings, &c., at North Bay (£3,500), for the T.C.

SHEFFIELD.—Extensions to the applied science and other departments of the University, for the Council of the University (£16,000). Alterations and improvements to Clayton Wesleyan Methodist Church (£600).

SHIREMOOR.—Workmen's institute; T. McMillen, architect, Shiremoor.

SOUTHALL-NORWOOD.—Addition to factory, White Street, for Naylor Bros.

SOUTHPORT.—Proposed new Council school between Wennington Road and Canning Road; Secretary to Education Committee, Town Hall.

SOUTH SHIELDS.—New schools, Stanhope Road, for the T.C.; T. A. Page and Son, architects, South Shields.

STAINES.—Chapel, lodge and other buildings, at the new cemetery; E. J. Barrett, Surveyor to the U.D.C., Town Hall, Staines.

STALYBRIDGE.—New offices, in Park Road, for Bailey & Garnett, Ltd. Proposed new church, in Lord Street (£1,500-£2,000).

(Continued on page xxiv.)

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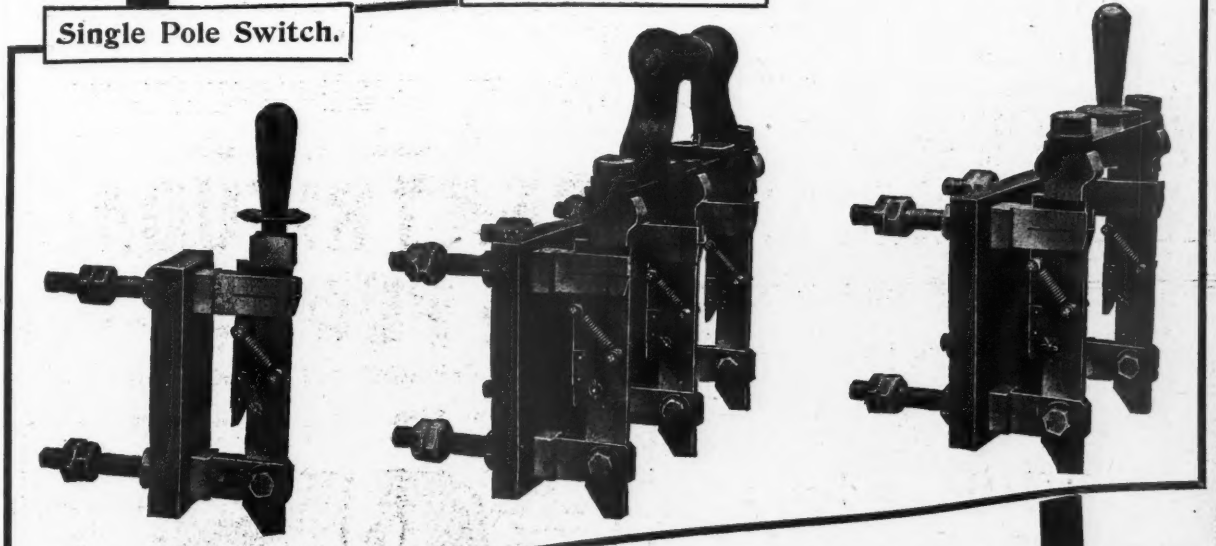

CONTRACTORS' COLUMN.—*Continued from page* xxii.

STRATFORD-ON-AVON.—Houses for working classes; R. Dixon, Borough Surveyor.
SWANSEA.—Additions, Swansea Baths and Laundry, St. Helen's Road.
TARPORLEY (Cheshire).—New school contemplated; Secretary, Cheshire Education Committee.
TOTTINGTON (near Bury).—Proposed slipper baths; Tottington Council.
TRURO.—Extensions to P.O., for H.M. Office of Works, Storey's Gate, S.W.
WARE (Herts.).—Residences, for P. Arnold and S. Harrington; H. Norris and Son, builders, Priory Works, Hertford.
WARMLEY (near Bristol).—Proposed isolation hospital; Clerk to the D.C.
WARWICK.—Children's receiving home, Wharf Street; C. H. Passman, Clerk to the B.G.
WATERLOO (near Liverpool).—Conversion of premises, 1, Bath Street, and 4, South Road, into shops, for T. Wardlow. Hangars, Sandheys Avenue, for H. G. Melly.
WAVERTON (near Wigton).—New Vicarage House; the Vicar.
WELTON (Yorks.).—New Council school and teacher's house; Building Surveyor, County Hall, Beverley.
WEM (Salop).—Proposed public cattle market (about £3,000); Clerk to U.D.C.
WESTBOURNE (Sussex).—School; L. Thompson, Secretary, Education Committee, West Sussex C.C., Horsham.
WEST HARTLEPOOL.—Secondary school (£10,000); N. P. Denning, Borough Surveyor, Town Hall, West Hartlepool.
WEST KIRBY.—Proposed high school for girls; W. P. Horsburgh, Quantity Surveyor, Liverpool.
WHITECRAIGS.—Villa (£2,000); H. E. Clifford, architect, 225, St. Vincent Street, Glasgow.
WHITEHAVEN.—Sawmill, Coach Road, for J. & W. Jackson, timber merchants.
WILLASTON (Cheshire).—Alterations at Willaston school contemplated; Managers.
WOLVERHAMPTON.—Salvation Army citadel (£2,000); G. Cave, builder, Raby Street, Wolverhampton.
WORSTHORN.—Proposed workmen's dwellings at Hurstwood Green; Clerk to the U.D.C.
YEOVIL.—New school in connection with the Congregational Church (£2,000); Rev. A. W. G. Butt, pastor. Additions to factory, for Clothier & Giles, glove manufacturers.
YOKER.—Extension of works, for Bull's Metal and Melloid Co., Ltd. Alterations to business premises, 23, Covey Street, for L. Iles, milliner, &c.

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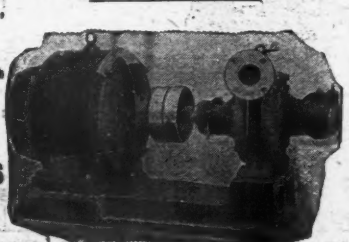
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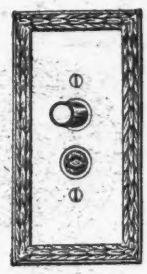

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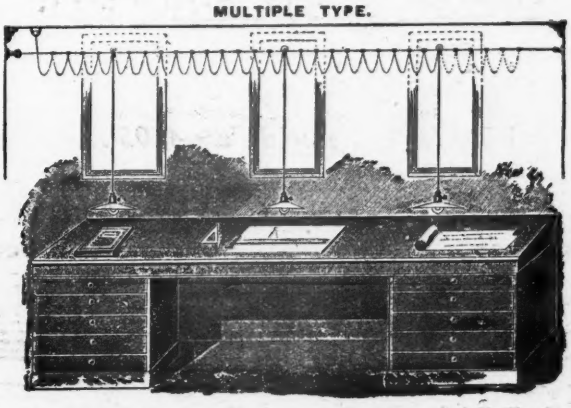

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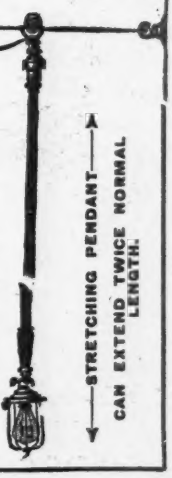

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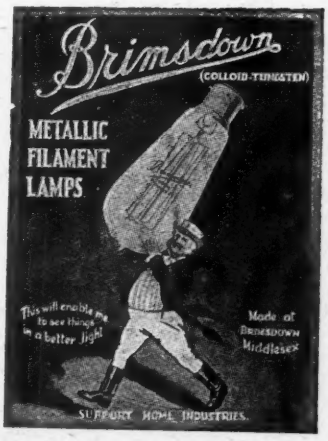

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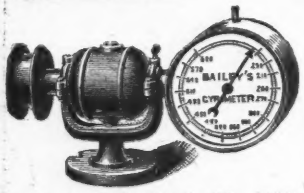

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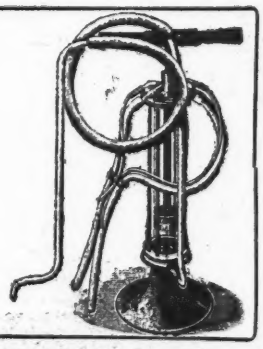

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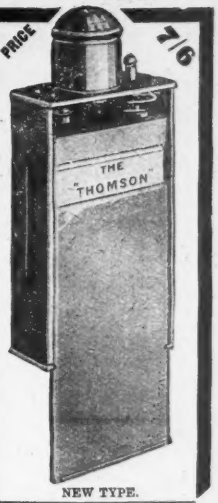

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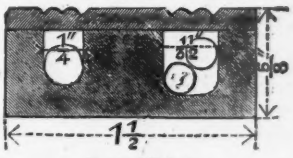

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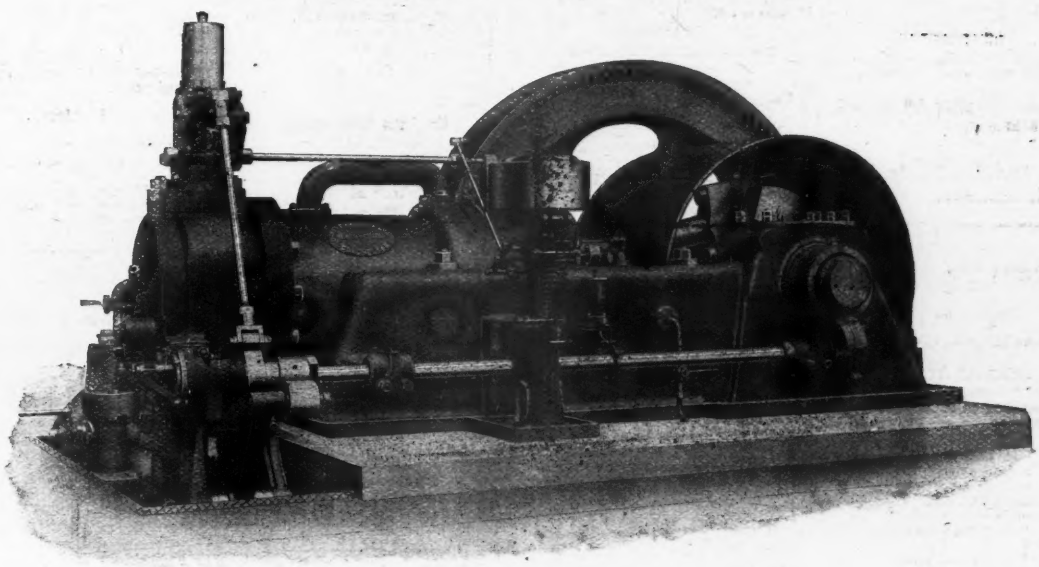

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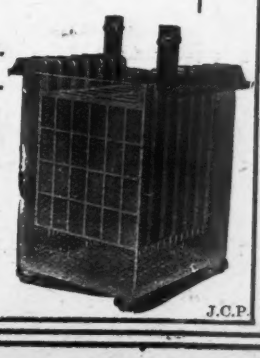

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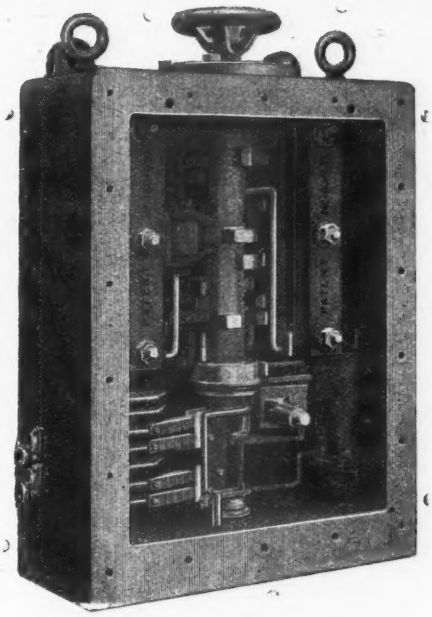

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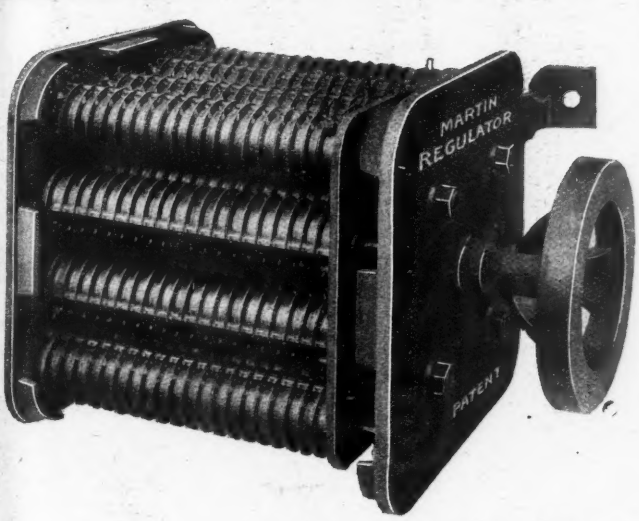

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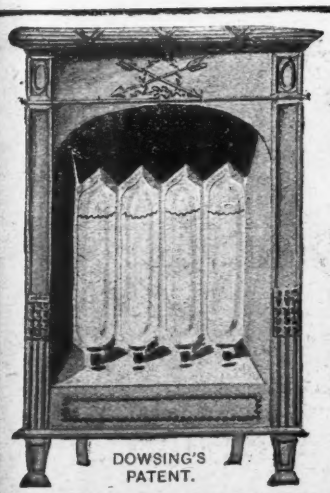

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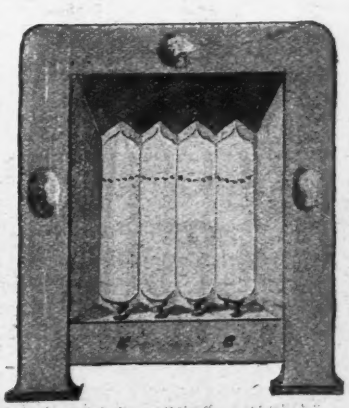

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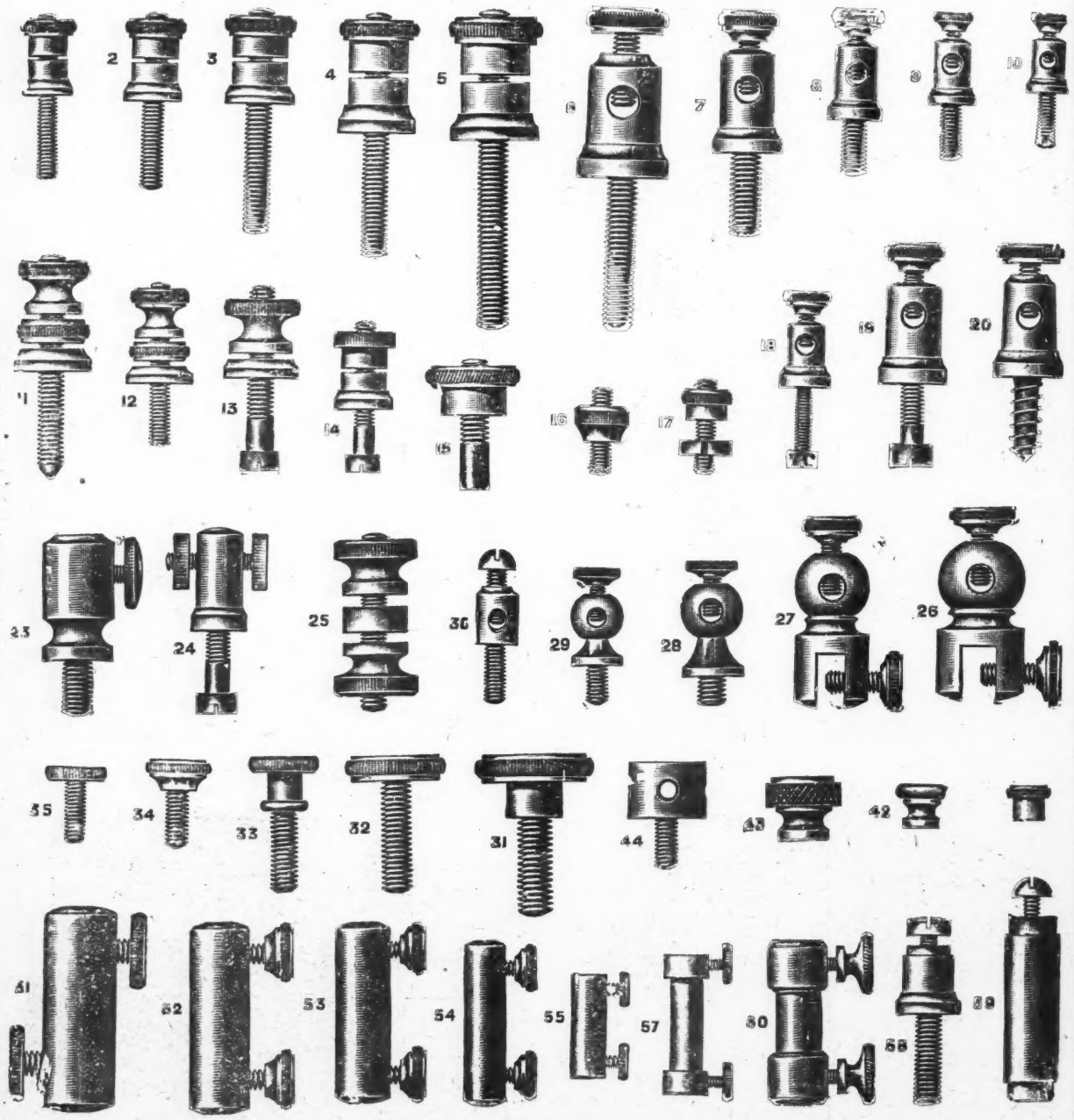

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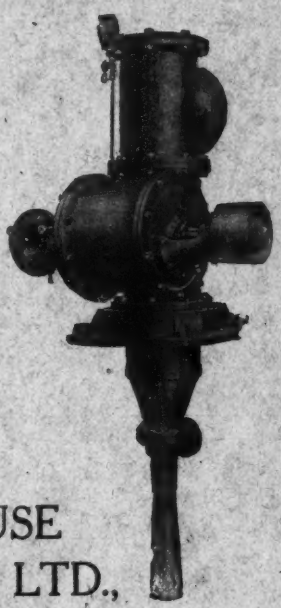

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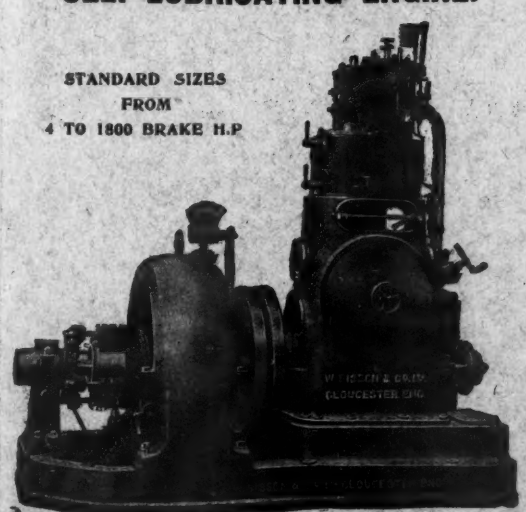

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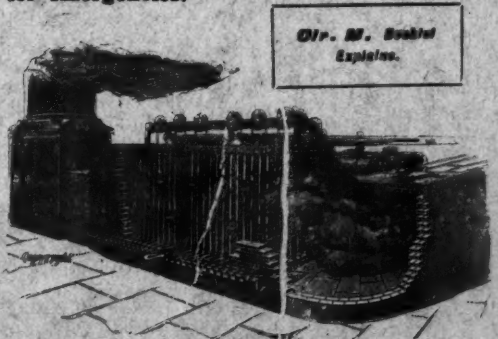

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